

Sundstrand Corporation



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July 24, 1985

Emergency Response Unit
Illinois Environmental Protection Agency
2200 Churchill Road
Springfield, IL 62706

Attention: Mr. James P. O'Brien

Dear Mr. O'Brien:

With reference to our telephone conversation of July 17, 1985, please find enclosed two copies of Sundstrand's Proposed Remedial Action Plan relating to the toluene release at our plant at 4747 Harrison Avenue.

Based upon our conversation, it is my understanding that after the Illinois Environmental Protection Agency has had the opportunity to review the Proposed Remedial Action Plan you will arrange a meeting with us so that the Plan can be discussed. As I indicated to you, we would like to have the meeting during the first week in August if that is possible.

We look forward to meeting with you at your convenience.

Very truly yours,

SUNDSTRAND CORPORATION

William R. Coole
Assistant General Counsel

WRC:jmf

Attachments

cc: Chuck Corley

PROPOSED REMEDIAL ACTION PLAN

FOR

TOLUENE RECOVERY

AT THE SUNDSTRAND PLANT

LOCATED AT

4747 HARRISON AVENUE

ROCKFORD, ILLINOIS

I. Introduction

A. Description of the release.

At its facilities located at 4747 Harrison Avenue Sundstrand maintains test cells which are located south to southeast of the main office building (See Figure #1). The test cells contain a runoff drainage system which is connected by pipe to a concrete spill containment sump (the "sump") which is used to collect liquids that are spilled within the test cells. In August of 1984 Sundstrand began dismantling equipment located in one of the test cells which had been used in conjunction with its Organic Rankin Cycle Program. As a preliminary to dismantling the equipment it was necessary to drain the toluene which was used in the equipment as a heat exchange medium. Accordingly, on August 31, 1984 between 600 and 800 gallons of toluene was drained from the equipment and barrels located in the test cell and was retained in the sump for subsequent disposal.

On September 4, 1984, a properly licensed waste hauler engaged by Sundstrand removed approximately 2,200 gallons of liquid from the sump. Following transport of the liquid to its facility, the waste hauler tested the waste and advised that there was little or no toluene in

the liquid which had been pumped from the sump. On September 19, 1985 the waste hauler returned to Sundstrand and removed the entire contents of the sump, approximately 2,400 gallons of liquid. Upon sampling the second load at its facilities the waste hauler advised that there was little or no toluene in this load.

Sundstrand later contacted Fehr-Graham and Associates, Consulting Engineers, to assist in determining whether the toluene had been released from the sump.

The location and construction detail of the spill containment sump is shown on Figure #1 and Figure #2.

Following several weeks of study and both internal and external examination of the sump the conclusion was reached that the sump was not secure and that a mounded water table existed in the vicinity of the sump. Accordingly, it has been surmized that water was able to enter the sump at its base and as the water level rose the toluene was able to escape from the sump through concrete joints at the top. As this determination was made, contact was made on December 7, 1984 with the National Response Center and the Illinois Environmental Protection Agency to advise them of the toluene release.

B. Scope of this report.

Analysis of water samples from the monitoring wells that were installed to provide hydrogeologic information and contaminant levels resulting from the toluene release indicate that additional volatile organics in low concentration exist on the site. This report only addresses the toluene release of August 31, 1984, the subsequent movement of the toluene in the groundwater and the remedial action plan to remove the toluene from the groundwater. Sundstrand has taken action to reduce

and/or eliminate the source of the other contaminants and has undertaken a preliminary hydrogeologic study relative to the other volatile organics on the site.

Because the plume of contamination contains a high concentration of toluene and is in a relatively small area Sundstrand is of the opinion that remedial action addressing the plume is appropriate. Accordingly, we intend to install a recovery well close to the leading edge of the plume and pump the groundwater containing the toluene to an airstripper that is designed to remove not less than 99% of the toluene and other volatile organics from the water. The water discharged from the airstripper will then be used to flush the contaminated unsaturated soil along the flow path from the source of the toluene release to the recovery well and/or discharged to the Sanitary District of Rockford wastewater treatment plant (POTW).

C. Summary of regional hydrogeology and groundwater use.

Sundstrand's plant site at 4747 Harrison Avenue is in excess of 80 acres and is located in T43N, R2E of the 3rd P.M. in Winnebago County. The topography of the area surrounding the site is shown on Figure #3. The site is in an upland area between the Rock River and the north branch of the Kishwaukee River. It is within the surface watershed of the Rock River. The site is generally flat and lies along the fringe of the upland area. Locally steep slopes occur south of the site due to a valley tributary to the Rock River.

The stratigraphic column typical of Boone and Winnebago Counties is shown in Figure #4. Beneath the plant site, dolomite belonging to the Galena Group forms the uppermost bedrock unit. Above this bedrock is approximately 20 to 80 feet of glacial sediment. Figure #6 also shows deep erosion of the bedrock surface forming

valleys in the bedrock. These valleys were formed in recent geologic time (Quaternary time) and have been filled by Quaternary glacial sediments. In the Rockford area, a prominent north-south trending bedrock valley is 400 feet deep penetrating into the St. Peter Sandstone. In the deeper portion of this bedrock valley, the sediments consist of sand and gravel glacial outwash and is a primary source of water supply for the City of Rockford. Figure #5 is a topographic map of the bedrock surface showing the locations of the deep bedrock valleys with respect to the plant site.

Bedrock formations which are fresh water aquifers are the St. Peter Sandstone, Ironton-Galesville Sandstone, and Mt. Simon Sandstone. The St. Peter Sandstone is in hydraulic communication with the glacial aquifers which fill the bedrock valley. The deeper bedrock aquifers (Ironton-Galesville, and Mt. Simon Formations) do not have good hydraulic communication with shallower aquifers because they are beneath the less permeable Potosi, Franconia, and Eau Claire Formations. Accordingly these deep aquifers are better protected from contamination.

The City of Rockford has approximately 40 municipal water supply wells. About half of these wells are in the sandstone aquifers and are fairly evenly distributed throughout the City. The City well nearest the Sundstrand plant site is located across the street north of the plant and is 1,313 foot deep. Shallower City wells are located in the sand and gravel aquifer in a north-south trend over the bedrock valley.

The Galena and Plattsville Groups comprise 300+ feet of dolomite and are the uppermost bedrock units underlying the plant site. Although these dolomites are

not considered a high yield aquifer, joints, bedding planes, fractures, and solution openings do provide adequate water for residential use. Groundwater within this dolomite recharges the Mt. Simon Formation and the sand and gravel deposits in the bedrock valleys.

D. Applicable Illinois statutes and rules.

The March 1, 1984 rules and regulations of Title 35; Environmental Protection Subtitle G; Waste Disposal Chapter 1; Pollution Control Board State of Illinois are applicable to the toluene spill.

II. Extent of contamination.

A. Methods of investigation and quality control.

In an effort to determine if there was any groundwater contamination, Monitoring Wells 1, 2, 3, 4, 5, 6, and 7 were installed in November and December of 1984. These wells were located as shown on Figure #1. Monitoring Wells 1, 2, 3, 4, and 5 were installed at different depths to determine in addition to contamination, the hydrogeologic conditions adjacent to the suspected toluene release. Monitoring well 6 was installed as an upgradient monitoring well and Monitoring Well 7 was installed as a downgradient monitoring well. All monitoring wells were installed as follows:

1. A 7 1/2 inch hollow stem auger was used in the soil portion of drilling to a depth not to exceed 50 feet.
2. A 4 inch rotary drill was used to penetrate rock or for depths of greater than 50 feet.
3. During rotary drilling, water was used for flushing. If caving was encountered, a minimal amount of drilling mud was used.

4. The drilling was completed to a depth of 1 to 2 feet beyond the planned well bottom elevation. This allowed for fines to settle and a gravel base to be installed.
5. A 5 foot screened section with 0.010 inch slots was set at the bottom.
6. Two inch PVC pipe was then attached in 10 foot lengths. The flush treaded fittings were used with Teflon tape to seal joints.
7. The 2 inch PVC riser pipe and screen were installed to the required bottom elevation through the 4 inch center of the hollow stem auger. The top was taped to prevent gravel or other contaminants from entering.
8. Washed 1/4 inch pea gravel was added around the well screen to a level of 1 to 2 feet above the screen. When a bentonite slurry was used in drilling, it was rinsed out by forcing clean water down the well.
9. One foot of bentonite clay seal was installed directly above the pea gravel.
10. The well was then sealed with a 90% portland cement and 10% bentonite clay by forcing the mixture down the boring with a pipe to the bottom of the well.
11. The auger was slowly and carefully removed and the portland cement mixture was added until approximately 4 feet from the surface.
12. The 2 inch PVC pipe was cut off 2.5 feet above ground. A PVC threaded cap was placed on top followed by a locking protective cover. This cover was then fixed in place with a concrete pad. The inside space was then filled with the cement/bentonite mixture.

13. After the completed well sat undisturbed for 48 hours the well was purged by pumping 3 to 5 volumes.

The actual dimensions of the monitoring well construction are shown in Figure #5 and the monitoring well logs are included in Attachment #3. These monitoring wells were drilled to provide groundwater level, flow direction, groundwater velocities, and toluene contamination levels. Monitoring Well 4 showed an abnormally high water table relative to the other wells.

A series of 10 soil borings were taken to a depth of approximately 25 feet in the area of the sump in an effort to determine unsaturated soil contamination and groundwater levels in the area of the sump. These borings labelled as B-1 through B-10 are located as shown on Figure #6. The toluene concentration in these borings is shown on Attachment #1.

The soil boring samples were collected as follows:

1. Soil samples were collected with a hollow stem auger and a split spoon soil sampler.
2. The hollow stem was augered to the desired depth and the split spoon was then attached.
3. The split spoon was washed prior to each sampling. All tools and equipment that made direct contact with the soil samples were cleaned as follows:
 - a. Washed with water to remove visible dirt.
 - b. Rinsed with acetone.
 - c. Rinsed three times with organic free water.
4. The split spoon was forced into the soil with a drillers hammer. The split spoon was extracted with an 18 inch sample.

5. The soil sample was removed from the spoon and placed in a sample jar utilizing organic free utensils. The sample jar was then placed into a chilled container for further processing.
6. After collection of all necessary soil samples from each boring location, the auger was removed and the boring was sealed.
7. Portland cement was mixed with finely ground soil. This mixture was gradually added back into the boring hole with a small amount of water.

Water levels from the soil boring information and the monitoring well water levels made it obvious that there was an artificially mounded water table in the vicinity of the sump. Additional soil borings WB-1 through WB-4 located as shown on Figure #6 were taken at a later date to better define the mounded water table and to determine if there was a direct connection between the mounded water table and the liquid level in the sump. WB-1 and WB-2 borings showed the groundwater level adjacent to the spill sump to be at a level of approximately 4.5 feet below the surface. The liquid in the sump was then dyed with a fluorescent dye and water was added to the sump to raise the water level in the sump above the water level in the surrounding ground. The fluorescent dye was immediately detected in borings WB-1 and WB-2 indicating a direct connection between the sump and the groundwater level. A leak in a non-contact cooling water pipe was later determined to be causing the mounded water table at the sump. It is believed the mounded water table caused water to enter the sump at its base and flush the toluene through the unsaturated soil and into the groundwater.

Monitoring wells 8, 9, 10, 11, 12, 13, 14, 15, and 16 were installed between December and February of 1985. These wells were located as shown on Figure #1. Monitoring wells 12, 13 and 14 were additional upgradient monitoring wells that were installed because monitoring well 6, which was originally expected to be an upgradient well, showed small concentrations of toluene. Monitoring wells 8 and 9 were installed to help define the groundwater flow and geology of the area. Monitoring wells 10, 11, 15 and 16 were installed to more accurately define the toluene plume movement and direction with time.

Sample collection and monitoring well water levels were obtained as follows:

1. Sample collection of groundwater from the monitoring wells is completed with the use of an ISCO bladder pump and Well Wizard control box.
2. The pump and Teflon discharge tubing were thoroughly cleaned before and after each daily sampling with the following procedure:
 - a. The pump was submersed in a phosphate soap solution which was flushed through the tubing.
 - b. Next organic free water was flushed through the pump and tubing.
 - c. This was followed with an acetone rinse.
 - d. Next 1 to 2 gallons of organic free water was flushed through the system.
 - e. A new bladder was installed between each daily sampling or job location.
3. The pump and Teflon tubing were cleaned between each well with the following procedure:
 - a. The pump was submersed in a phosphate soap solution and then emptied of its contents.

- b. The pump was rinsed and 3 pump volumes of organic free water which were drawn through the pump and tubing.
4. Each monitoring well was evaluated for the contaminants expected and the level at which they might exist. The well least likely to contain contaminants or the well with the lowest concentrations was sampled first.
5. After the well has been unlocked and the cap removed, the following information was gathered and recorded.

Static depth (groundwater elevation) was measured with an electrical circuit meter. This measurement was taken to .01 of a foot. The elevation of the groundwater was obtained by subtracting the static depth from the elevation of the top of the PVC pipe. The meter was rinsed with organic free water between each measurement. The water levels are shown in Attachment #3.

6. The pump was lowered into the well and three well volumes of water were removed before sampling.
7. The temperature was taken just prior to collection of the water. The water was then collected from the Teflon tubing after slowing the pump speed down to eliminate vigorous mixing and aeration.
8. A duplicate sample was taken from each well and a field blank was collected daily by sampling the final rinse water in the cleaning process.
9. The pump was then removed from the well and cleaned prior to inserting in the next well.

Sample storage, preservation, and methods of analysis were as follows:

1. The samples gathered were immediately placed into a 4°C chilled cooler and were shipped directly to the laboratory.
2. Volatile organics required no preservative and were collected in a 40 ml glass vial with a Teflon cap (provided by the laboratory). The sample was void of air bubbles.
3. Upon delivery to the laboratory the chain of custody sheet was signed and dated. The samples were then refrigerated until analyses was completed.
4. Each sample vial was labelled with an identifying number, date, and company name. These are then all referenced to the chain of custody sheet.
5. The Laboratory Quality Assurance is included in the appendix as Attachment #4.

Monitoring well slug tests were completed on March 8, 1985 for the 16 monitoring wells to determine permeability and flow rates of the groundwater in the formations that were penetrated by the monitoring wells. These results and permeability calculations are shown in Attachment #2. The slug tests were conducted in the monitoring wells by dropping a 0.06 or a 0.066 cubic foot volume in the monitoring well and causing a sudden rise in level of the water level in the monitoring well. The time was then recorded for the monitoring well water level to recede to its static level. This information was analyzed by the method of Hvorslev (1951) as described by Freeze and Cherry (1971). The calculated permeabilities are as follows:

<u>MW#</u>	<u>Material</u>	<u>Depth (Ft.)</u>	<u>Permeability (Ft/sec)</u>
1	Dolomite	126.6	1.1×10^{-6}
2	Fractured Dolomite	42.5	6.1×10^{-7}
4	Till	11.4	4.0×10^{-5}
5	Dolomite	65.1	1.9×10^{-5}
6	Fractured Dolomite	38.0	4.7×10^{-7}
7	Till	30.6	4.4×10^{-6}
8	Till	19.0	4.1×10^{-6}
9	Fractured Dolomite	52.5	6.0×10^{-6}
10	Dolomite	87.4	9.3×10^{-5}
13	Dolomite	65.6	1.0×10^{-5}
14	Dolomite	100.6	9.0×10^{-6}
15	Dolomite	50.0	1.2×10^{-6}
16	Dolomite	200.6	2.5×10^{-4}

The geometric mean of the permeability in the dolomite formation is 6.0×10^{-6} feet per second.

B. Evaluation of results.

1. Soil stratigraphy.

Sixteen monitoring wells and ten borings have been drilled on the plant site at the locations shown on Figure #1. Logs of these monitoring wells are in Attachment #3. Based on these logs, the depth to bedrock is quite variable, ranging from 14 feet at well 6 to 80 feet at well 16. In the immediate area of the sump, the depth to bedrock is approximately 25 feet.

The glacial sediment above the bedrock consists primarily of sand and silt, with some clay and gravel intermixed. The upper part of the bedrock is weathered and highly fractured, resulting in an uneven boundary between the dolomite and the till. The highly fractured zone extends 30 to 35 feet into the bedrock.

2. Groundwater occurrence and movement.

The toluene contamination is contained in the upper low permeability dolomite formation that is protected from the portable groundwater aquifers, namely the St. Peter Sandstone and Mt. Simon aquifers, by impermeable layers as shown in the soil stratigraphy cross sections previously.

The groundwater level in the area of the toluene plume is approximately 33 feet below the surface and 12 feet below the top of the Dolomite formation. Piezometric contours are plotted on Figure #8 from the monitoring well water level elevations. It can be seen that groundwater movement in the area of the toluene plume is in a southwesterly direction from the spill containment sump in the direction of Monitoring Well #15. The groundwater also moves vertically downward along this path.

As previously mentioned, the leaking cooling tower piping caused a mounded water table 4.5 feet below the surface at the sump. The mounded water table had an approximate 55 foot radius at which point it intersected the normal water table which was approximately 33 feet below ground surface. This mounded water table carried the toluene from the sump through the till and into the

dolomite until it reached the normal water table. When the toluene reached the normal water table, it moved at the same rate as the groundwater.

Contaminants in groundwater move according to the processes of advection and dispersion. Advection is the movement of a contaminant due to hydraulic gradients. A contaminant moving solely by advection travels in exactly the same direction and at the same rate as the groundwater moves.

Dispersion is the movement and spreading of a contaminant due to chemical diffusion, retardation, and irregular velocities associated with individual aquifer pores. Dispersion tends to cause spreading and dilution of contaminant plumes. In relatively permeable aquifers, such as the dolomite at the Sundstrand site, advection is clearly the dominant process of contaminant transport. In the following discussion dispersion is ignored, and advective transport only is considered. The following discussion mathematically models the toluene movement from the spill containment sump through the groundwater. The toluene release from the sump flows through three distinct zones which are as follows:

Zone 1 - Mounded water table in the till

Zone 2 - Mounded water table in the dolomite

Zone 3 - Normal water table in the dolomite

These zones are shown in Figure #9. The Zone 1 horizontal hydraulic gradient of the mounded water table (see Figure #9) is 28.5 feet vertical over 55 feet of horizontal distance of 0.52 feet per foot. The calculated horizontal velocity in Zone 1 was calculated from the following formula:

$$V_{H1} = \frac{K I}{P} \times (86,400)$$

where

V_{H1} = horizontal velocity in feet/day in Zone 1

K = permeability of formation (MW#4) in ft/sec
calculated from slug test data as shown in the
Appendix

I = hydraulic gradient in feet/feet

P = porosity of formation = 0.3 (from the McWhorter
and Sunada, 1977 as prepared for Division of
Waste Management, and published in December
1982)

$$V_{H1} = \frac{(4.0 \times 10^{-5}) (0.52) (86,400)}{0.3} = 6.0 \text{ ft/day}$$

Groundwater in the mounded zone moves
vertically through the till and dolomite. Because
the permeabilities of these two materials are
different, the following formula was used to
calculate an equivalent permeability.

$$K_E = \frac{L}{\frac{L_T}{K_T} + \frac{L_R}{K_R}}$$

where

K_E = equivalent permeability of Monitoring Well 2
and Monitoring Well 4 in ft/sec

L = Vertical distance in feet

L_T = Vertical distance of till in feet

K_T = Permeability of till (MW#4) in ft/sec

L_R = Vertical distance of dolomite in feet

K_R = Permeability of dolomite (MW#2) in ft/sec

$$K_E = \frac{28.5}{\frac{16.5}{4 \times 10^{-5}} + \frac{12}{6.1 \times 10^{-7}}} = 1.4 \times 10^{-6} \text{ ft/sec}$$

The vertical hydraulic gradient was calculated from the difference in monitoring well 4 and monitoring well 2 water levels as 1.17 feet/feet. The vertical velocity in Zone 1 and Zone 2 is therefore:

$$\frac{(1.4 \times 10^{-6})(1.17)(86,400)}{0.3} = 0.5 \text{ feet/day}$$

Zone 3 calculations are for movement in the dolomite below the natural water table. Because of the normal variations in dolomite formations, it was decided to use the geometric mean permeability of all the field results (6.0×10^{-6} ft/day).

The horizontal velocity in Zone 3 was calculated using the hydraulic gradient between monitoring wells 2 and 15 or

$$\frac{4.17 \text{ feet}}{36 \text{ feet}} = 0.1158.$$

Therefore the horizontal velocity equals

$$\frac{(6.0 \times 10^{-6})(0.1158)(86,400)}{0.3} = 0.2 \text{ ft.day.}$$

The vertical velocity in Zone 3 varies with depth in the dolomite formation. In the upper part of the formation in the area of monitoring well 2, the vertical hydraulic gradient is

$$\frac{3.98 \text{ ft}}{13.48 \text{ ft}} = 0.30 \text{ feet/feet}$$

In the area of Monitoring Well 1 the vertical hydraulic gradient was closer to 0.006 feet/feet. Therefore the vertical velocity in the upper part of the dolomite formation was 0.5 feet/day downward and the vertical velocity in the area of Monitoring Well 1 was closer to 0.01 feet/day downward.

In summary the approximate velocities of the three zones are as follows:

$$V_{H1} = 6.0 \text{ ft/day}$$

$$V_{H1} = 0.5 \text{ ft/day}$$

$$V_{H2} = 0$$

$$V_{V2} = 0.5 \text{ ft/day}$$

$$V_{H3} = 0.2 \text{ ft/day}$$

$$V_{V3} \text{ upper} = 0.5 \text{ ft/day}$$

$$V_{V3} \text{ (90 ft deep)} = 0.01 \text{ ft/day}$$

Figure #9 traces the path of the mathematically modeled toluene plume as it left the sump on August 31, 1984.

3. Groundwater quality.

The following table shows the laboratory results for tulene concentrations in each of the monitoring wells.

Laboratory Results for
Toluene Concentrations
in Parts per Billion

MW#	Depth (ft.)	Dec. 7, 1984	Feb. 27, 1985	May 13, 1985
1	126.6	20	25	
2	42.5	4,700	2,700	463
4	11.4	377,000	133,000	****
5	65.1	22	18,600	105,000
6**	38.0	24	N.S.	N.S.
7***	30.6	N.D.	N.S.	N.D.
8	18.9	*	*	N.D.
9	52.5	*	*	N.D.
10	87.4	*	37	N.D.
11***	40.0	*	N.D.	N.S.
12**	31.0	*	N.D.	N.S.
13**	65.6	*	N.D.	N.S.
14**	100.6	*	N.D.	N.S.
15	50.0	*	20,400	13,500
16***	200.6	*	14	N.S.

* Well not completed.

** Upgradient well.

*** Downgradient well.

**** Well inadvertently destroyed by heavy machine operator.

N.D. Below detectable limits.

N.S. Not sampled.

The above laboratory results show the toluene plume to be approximately 65 feet below the surface and some 40 feet into the dolomite formation, Figures #10, #11, and #12 show the approximate toluene plume for their respective sampling dates. The mathematical model of the calculated theoretical path of the groundwater movement (Figure #13) shows the projected toluene plume for July 26, 1985.

III. Remedial Action Plan

A. Source elimination.

The sump which allowed the toluene to be released has been removed. All drain lines connected to the sump have been plugged. The non-contact cooling water pipe leak was repaired and the mounded water table has thereby been eliminated.

Remaining toluene in the unsaturated soils caused by the mounded water table will be addressed by injecting the discharge from the air stripping treatment facility or non-contaminated water into the soil at the former location of the sump. This will create an artificially mounded water table that will duplicate the original mounded water table thus flushing the unsaturated soil. The injection will be accomplished by a 10 foot long perforated 8 inch PVC drain tile placed 6 feet below ground surface in the area where the sump was formerly located.

The flushing of the unsaturated soil will continue until a level of less than 500 parts per billion of toluene in the soil is accomplished.

B. Groundwater purge system.

A proposed recovery well will be located as shown on Figure #6 to pump the groundwater containing toluene to an airstripping tower. Drawdown calculations for the proposed recovery well in the upper dolomite formation are based on the following:

Permeability = 6×10^{-6} ft/sec

Aquifer thickness = 300 feet

Storage = 0.1

Pumping duration = 30 days

Open hole length = 75 feet

Pumping rate = 20 gpm

Drawdown calculations were made using the Jacob Approximation for unsteady flow to a partially penetrating well. The drawdown curve is plotted on Figure #13. At a 75 foot pumping level, it is estimated that the recovery well will produce 20 gpm with a 42 foot drawdown. The 42 foot drawdown in the recovery well should allow the toluene plume to be substantially discharged to the recovery well as shown in Figure #6. The recovery well will be installed as shown on Figure #14 with start and stop level switches to maintain the drawdown at the 75 foot level. The submersible pump in the recovery well will be designed for a maximum of 40 gallons per minute at 125 feet of total dynamic head. This will require a one horse power submersible motor. The recovery well will pump directly to the airstripping tower.

C. Treatment System.

1. Design Conditions

Sundstrand's proposed recovery system will use a single purge well pumping at a rate of 20 gpm. It is estimated that the purge well will capture

groundwater with a concentration of toluene at 30 mg/l (ppm) and 1,1,1-trichloroethane at 3 mg/l. There are also other constituents in the groundwater at lesser concentrations. The purging of the groundwater will continue until a level less than 2,000 ppb total volatile organics is achieved.

There are inherent unknowns in groundwater cleanups such as the actual pumping rate necessary to capture the plume and actual initial contaminant concentrations. Therefore, a factor of safety will be included in the treatment system design as reflected in the following proposed design conditions:

Design Conditions

Flow rate:	20-40 gpm
Groundwater temperature:	55°F
Influent contaminant concentrations	
Toluene:	50 mg/l (ppm)
1,1,1-Trichloroethane:	4 mg/l (ppm)
Trichloroethylene:	0.2 mg/l (ppm)
1,1-Dichloroethylene:	0.2 mg/l (ppm)
Perchloroethylene:	0.2 mg/l (ppm)

2. Point of Discharge.

It is probable that at least part of the discharge from the air stripping tower will be used to effect soil flushing action. The excess discharge will be directed to the Sanitary District of Rockford wastewater treatment plant where the limit of 2.13 mg/l of total toxic organics (TTO) as defined and regulated by 40 CFR 433 will be met.

Alternatively, consideration has been given to release of the discharge to surface drainage. If this occurs, a toluene discharge limit of 2.0 mg/l will be addressed.

3. Proposed treatment.

Sundstrand proposes to treat the groundwater in a counter-current air stripping tower. This treatment method would use a single 24 inch diameter tower with approximately 25-30 feet of packing and an air flow rate of 400 cubic feet per minute. The tower will be designed to provide 99% treatment efficiency. Given the influent design parameters listed in Table 1, the total contaminant concentration in the effluent would be approximately 0.6 mg/l. A profile of the air emissions from this treatment method are listed in Table 1.

SUNDSTRAND CORPORATION

By: _____

Title: _____

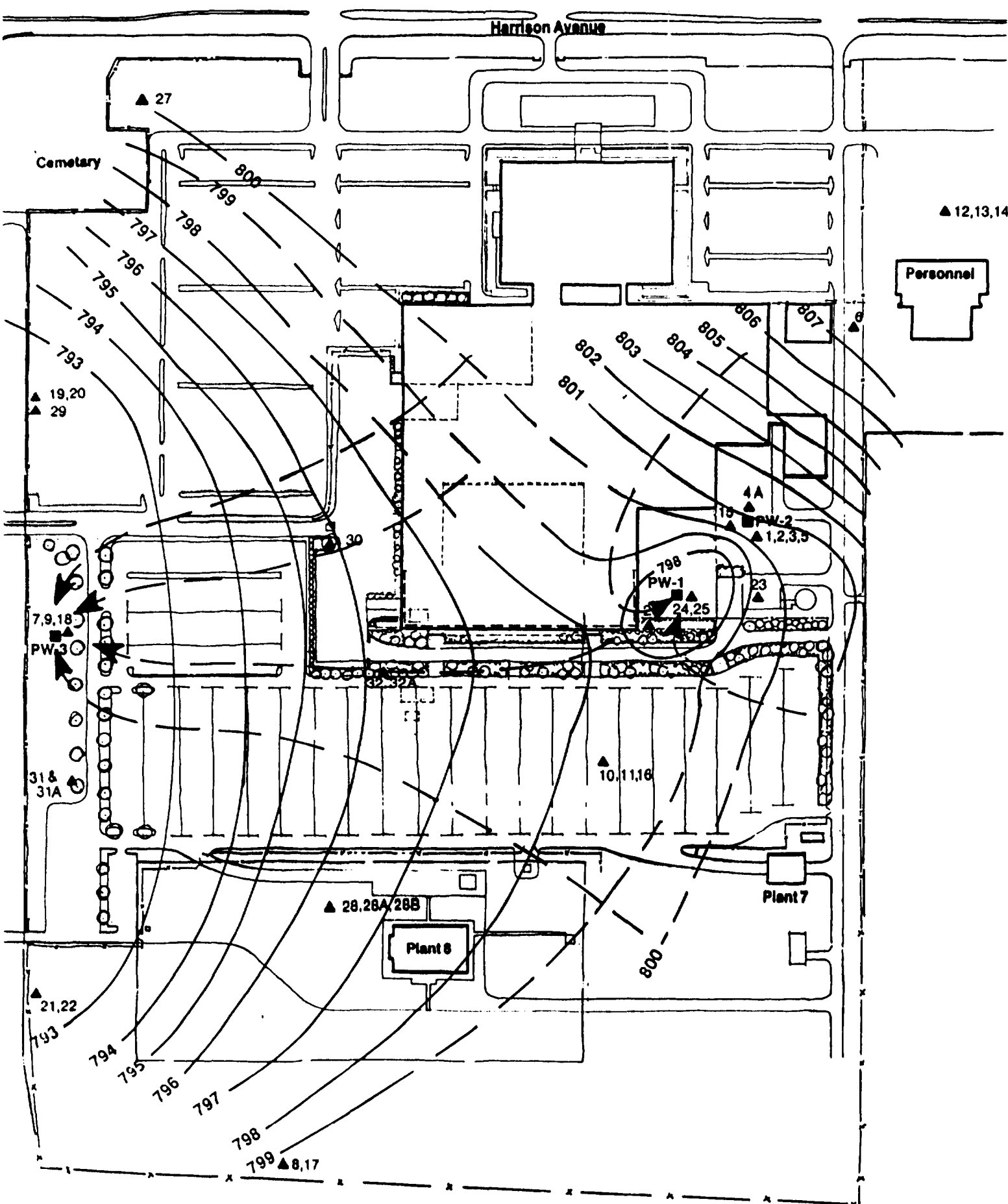
TABLE 1

AIR EMISSIONS PROFILE

Contaminant	Concentration at Tower Stack Exit				Est. 8-hr Conc. at 200 Ft*			Est. Annual Conc. at 200 Ft**	
	Mg/M ³	ppm	lb/hr	% TLV	ug/M ³	ppb	% TLV	ug/M ³	ppt
Toluene	660	172.3	0.989	172.3	163	42.6	4.3×10^{-2}	9	2350
1,1,1-Trichloroethane	52.71	9.51	0.079	2.7	13	2.35	6.7×10^{-4}	0.724	131
Trichloroethylene	2.67	0.49	0.004	1.0	0.66	0.12	2.4×10^{-4}	0.037	7
1,1-Dichloroethylene	2.67	0.67	0.004	6.7	0.66	0.17	1.7×10^{-3}	0.037	9
Perchloroethylene	2.67	0.39	0.004	0.8	0.66	0.10	1.9×10^{-4}	0.037	6

* Based on an estimated average 8-hour dispersion value of 4045 at 200 ft. from the source.

** Based on an estimated average annual dispersion value of 72,810 at 200 ft. from the source.



Legend

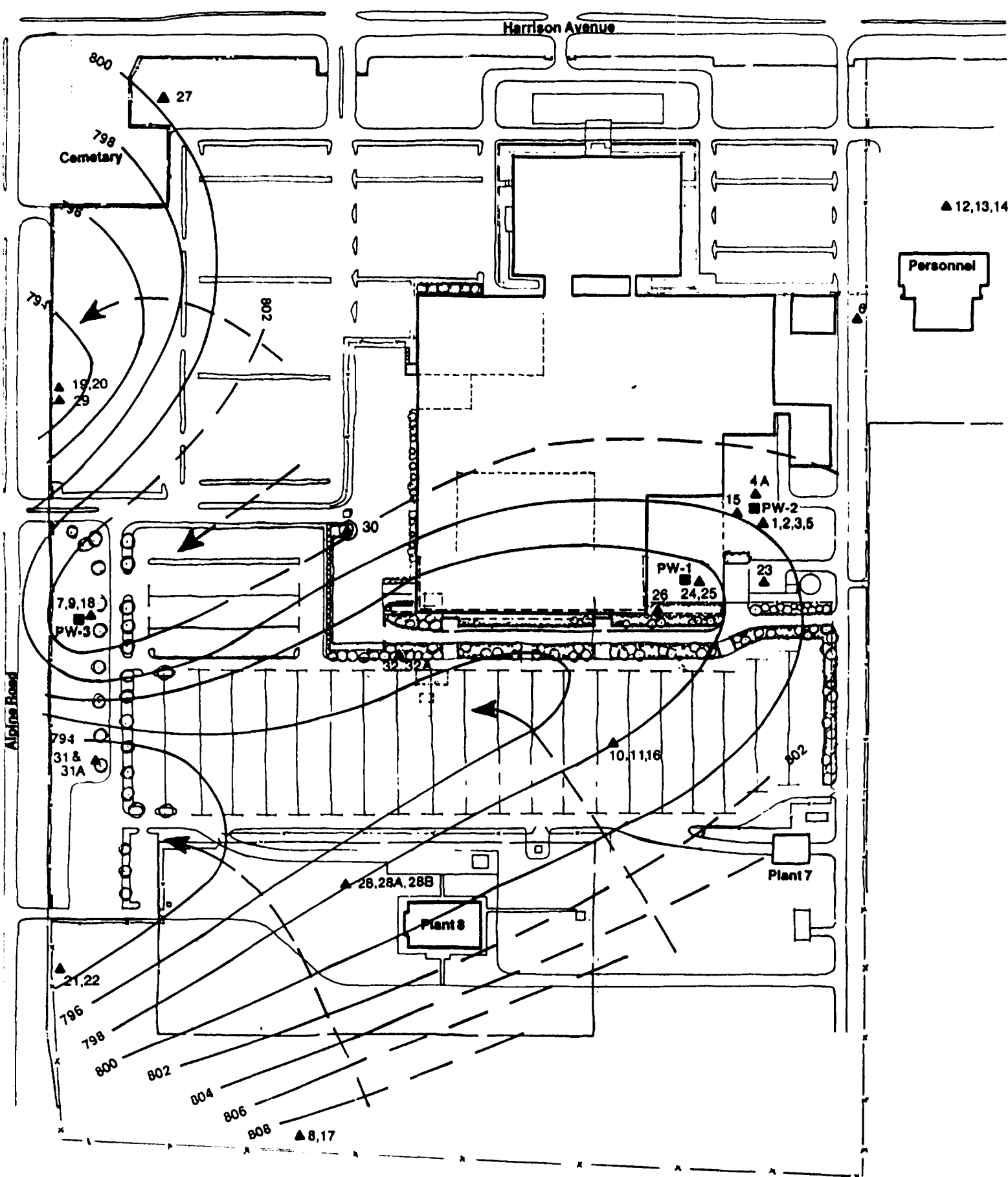
- ▲ Well
- Purge Well

- Direction of Groundwater Flow
- 800 — Contour Connecting Points of Equal Groundwater Elevation



Contours Based On March 27, 1989
Measurements. Purge Well Pumping
Rate: PW1 + PW2 at 21.5 gpm PW3 at
9 gpm

Figure 8
**WATER LEVEL CONTOURS FOR
BEDROCK WELLS**
SUNDSTRAND CORPORATION
ROCKFORD, ILLINOIS



Legend

- ▲ Well
- Purge Well

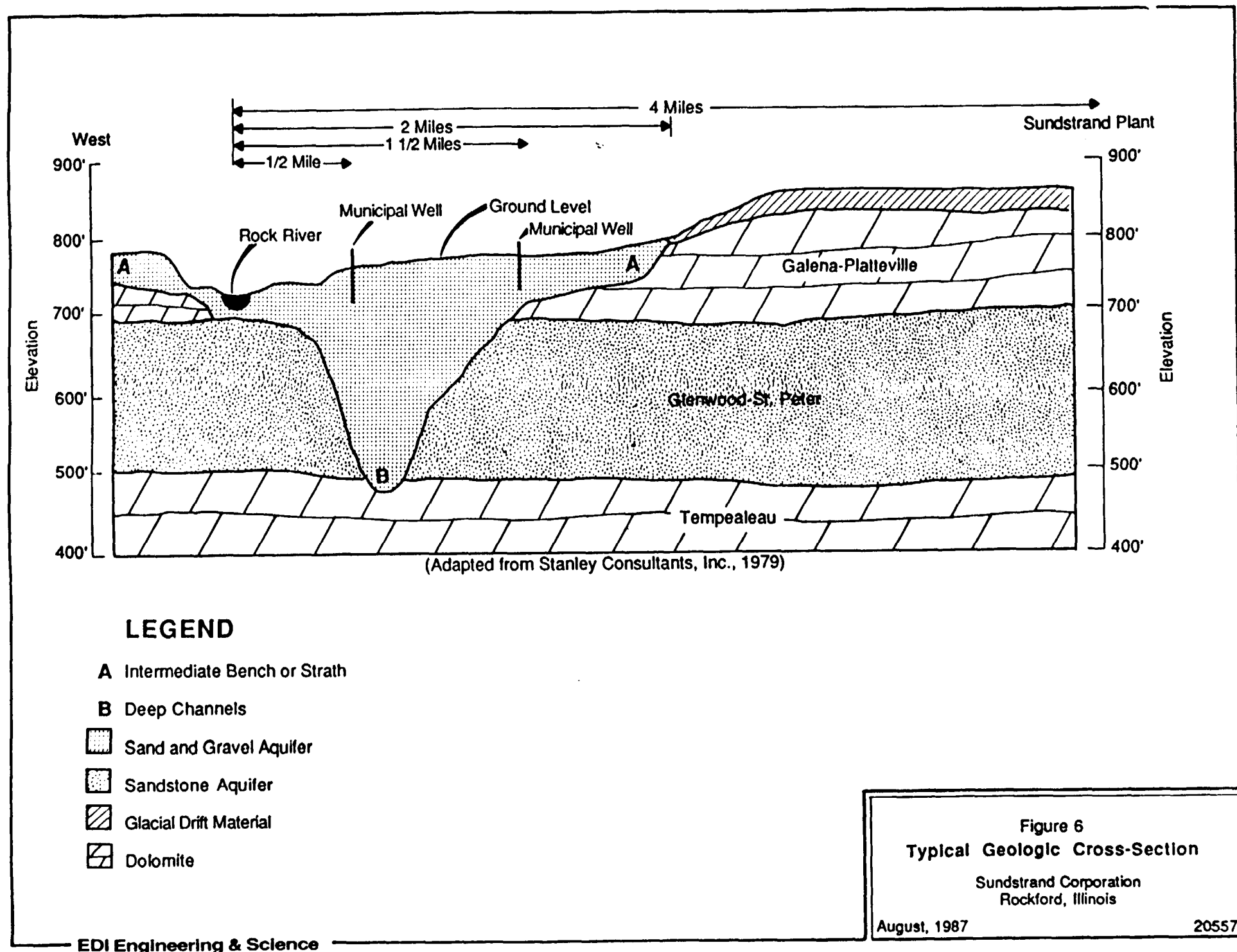
- Direction of Groundwater Flow
- 800 — Contour Connecting Points of Equal Groundwater Elevation

Contours Based On March 27, 1989
Measurements. Purge Well Pumping
Rate: PW1+PW2 at 21.5 gpm PW3 at
9 gpm

Figure 7
**WATER LEVEL CONTOURS
FOR GLACIAL DRIFT WELLS**
SUNDSTRAND CORPORATION
ROCKFORD, ILLINOIS

March, 1989

20557



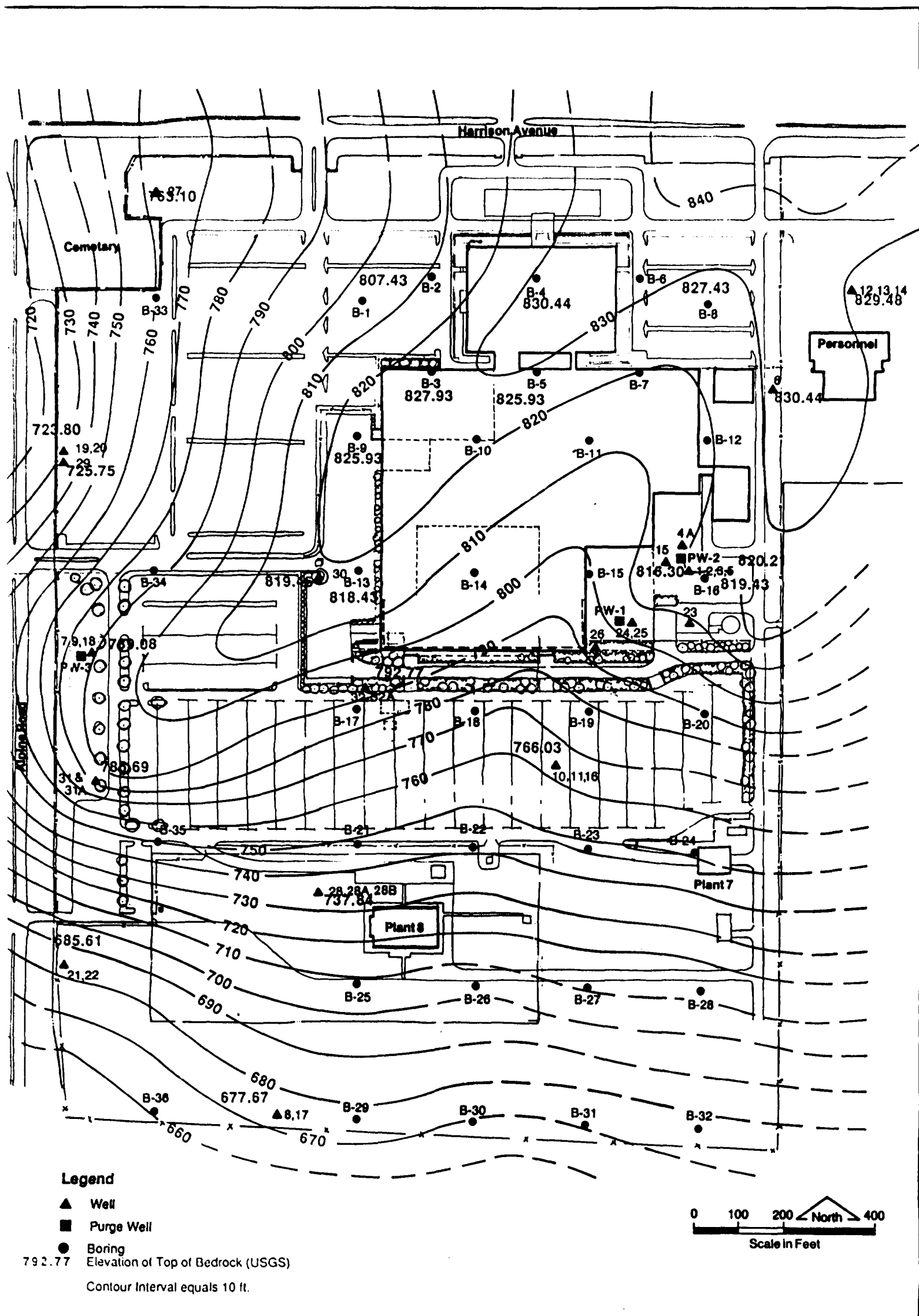
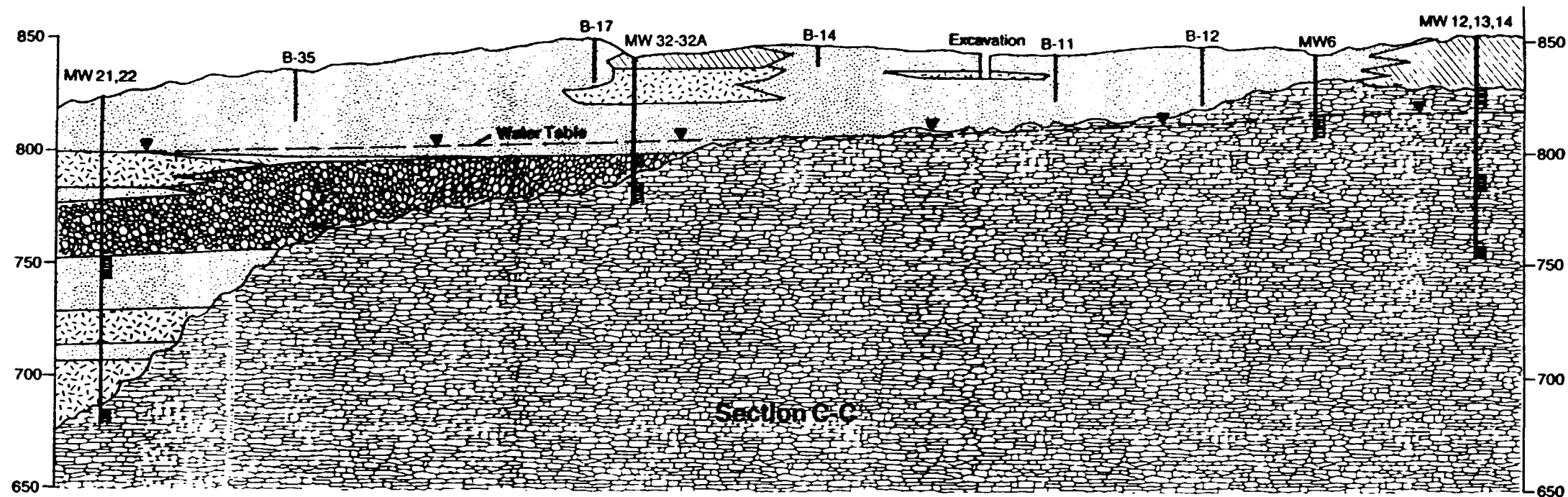


Figure 5
Topography of Bedrock Surface
 Sundstrand Corporation
 Rockford, Illinois
 March, 1987

(Southwest)

(Northeast)



Legend

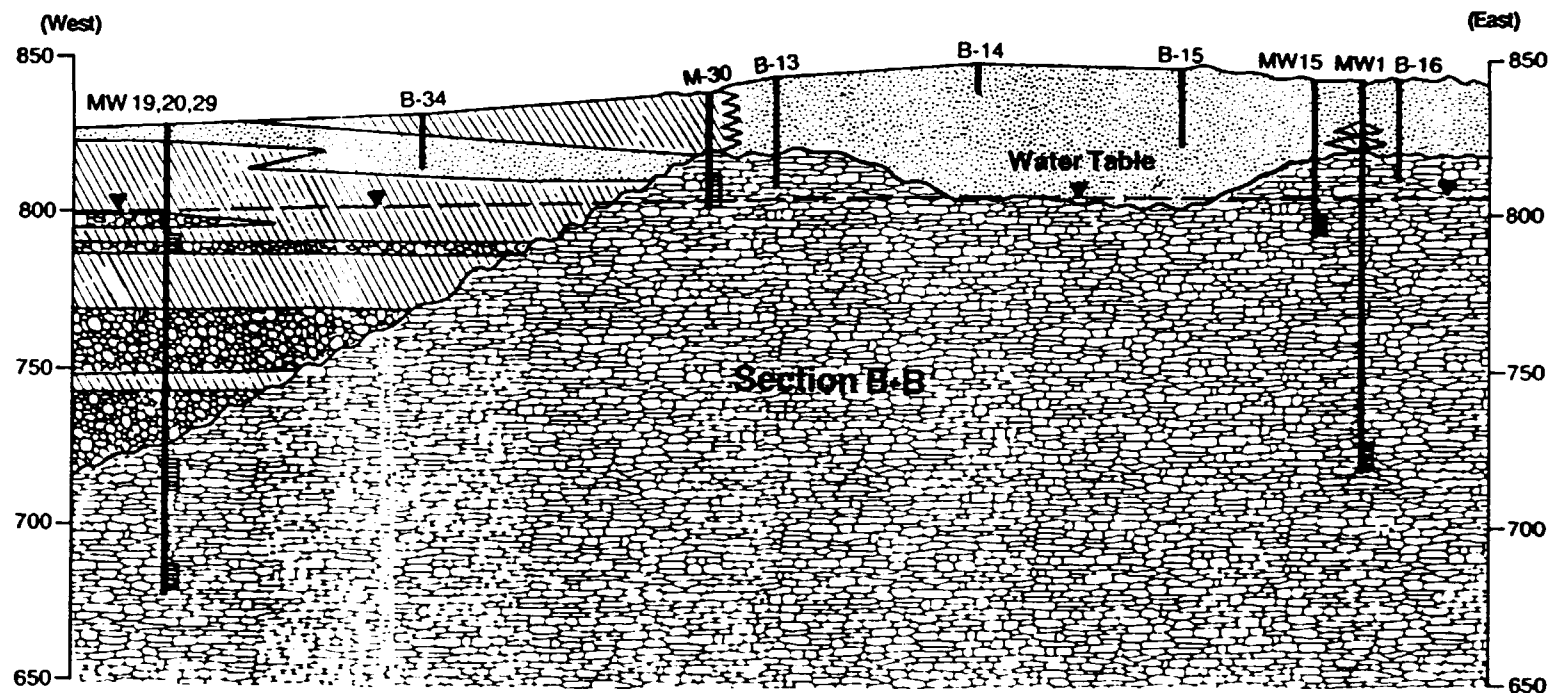
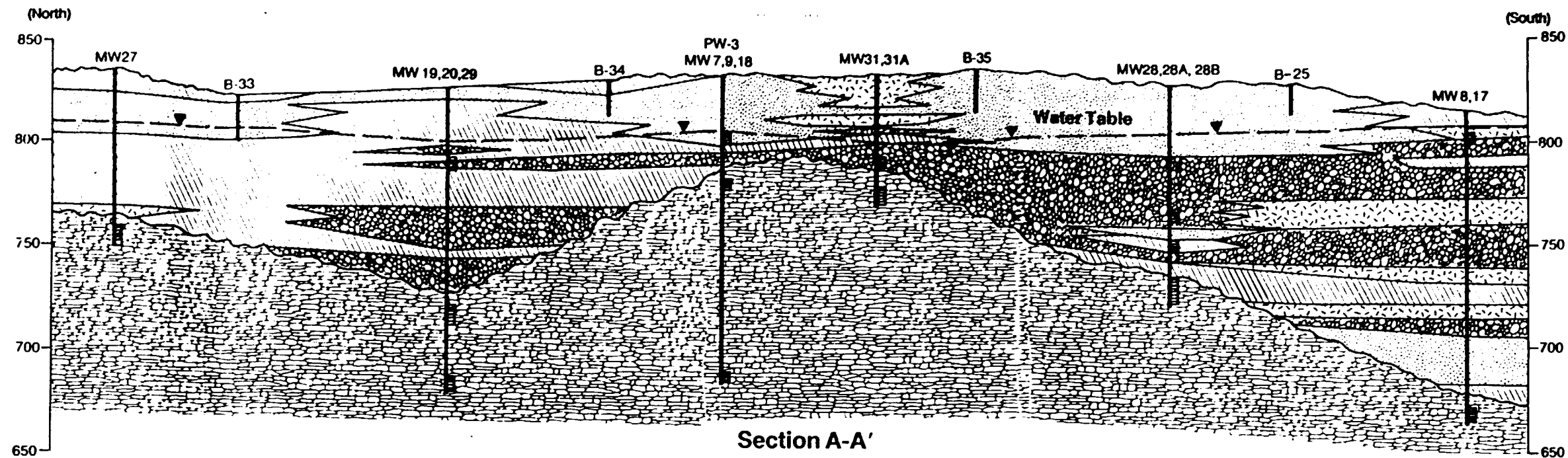
- Clay, Silty to Gravelly
- Silt, Clayey to Sandy
- Sand, Clayey to Gravelly
- Gravel, Clayey to Sandy
- Dolomite Bedrock
- Contact Between Soil and Bedrock (Unconformity)
- Completed Intervals

Horizontal Scale: 0 50 100 200
Vertical Scale: 4x Scale in Feet

Figure 4
Cross Section C-C'
Sundstrand Corporation
Rockford, Illinois

March 1987

20557



Legend

- Clay, Silty to Gravelly
- Silt, Clayey to Sandy
- Sand, Clayey to Gravelly
- Gravel, Clayey to Sandy
- Dolomite Bedrock
- Contact Between Soil and Bedrock (Unconformity)
- Completed Intervals

Horizontal Scale: 0 50 100 200
 Vertical Scale: 4x Scale in Feet

Figure 3
Cross Section A-A' and B-B'
 Sundstrand Corporation
 Rockford, Illinois

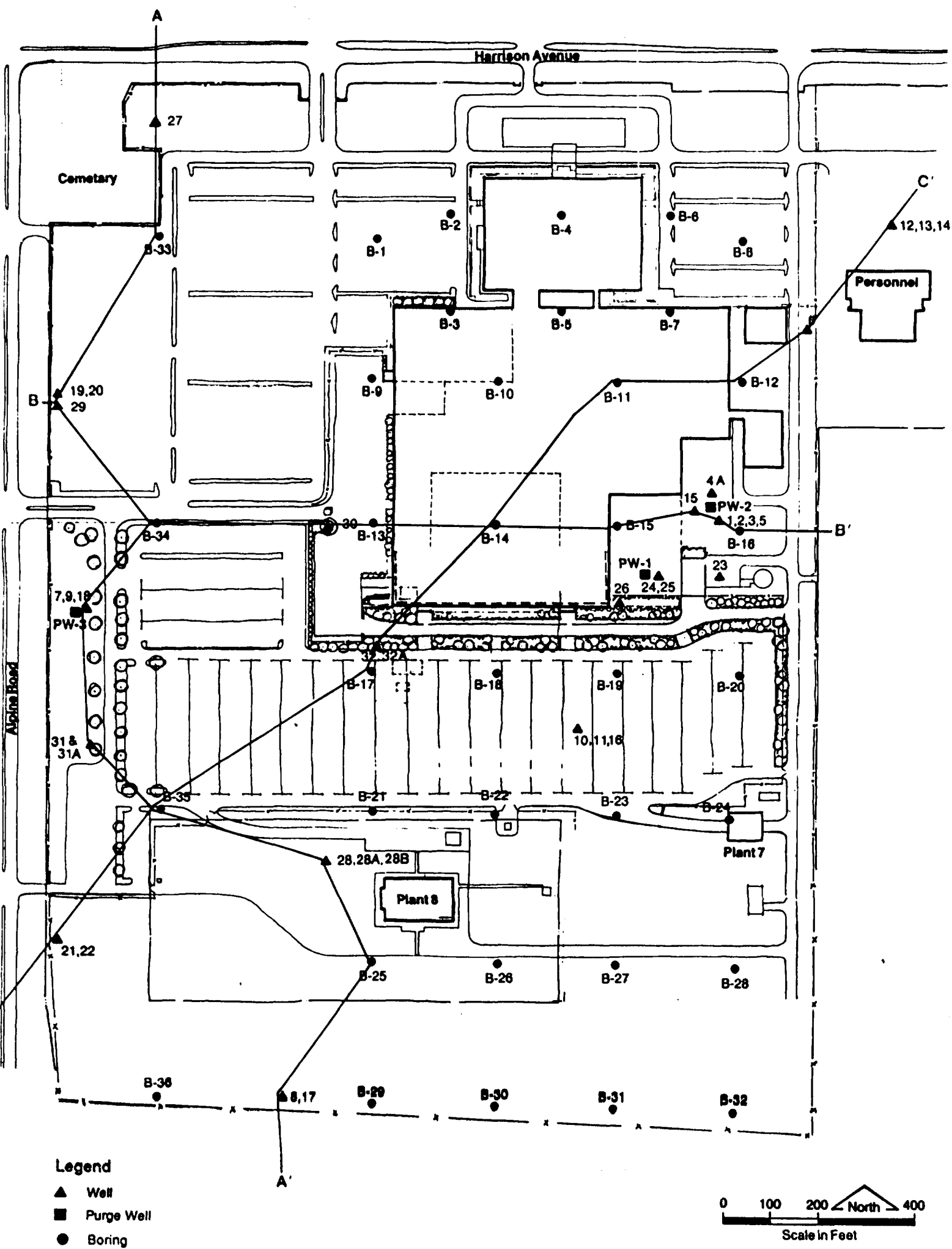
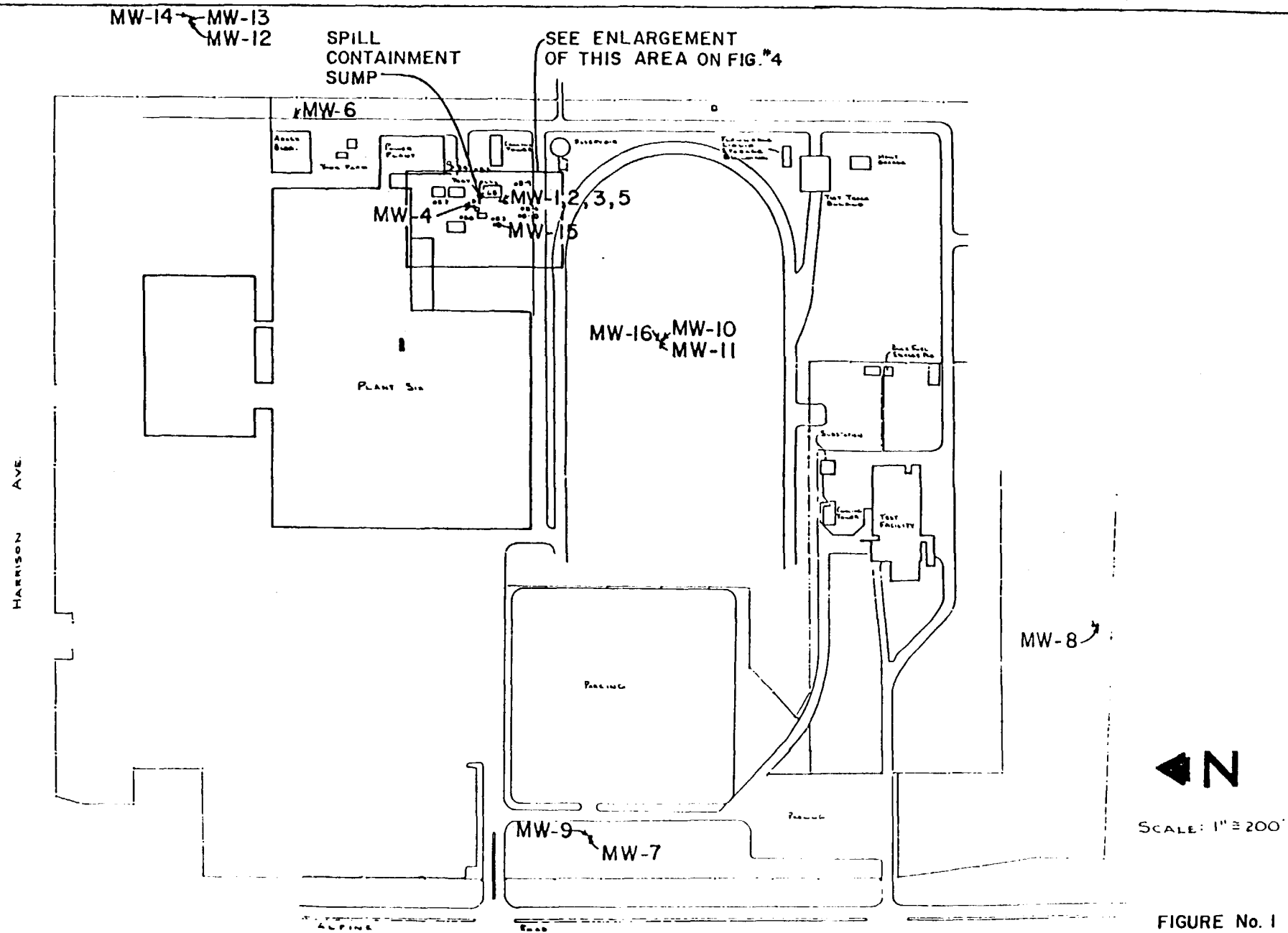
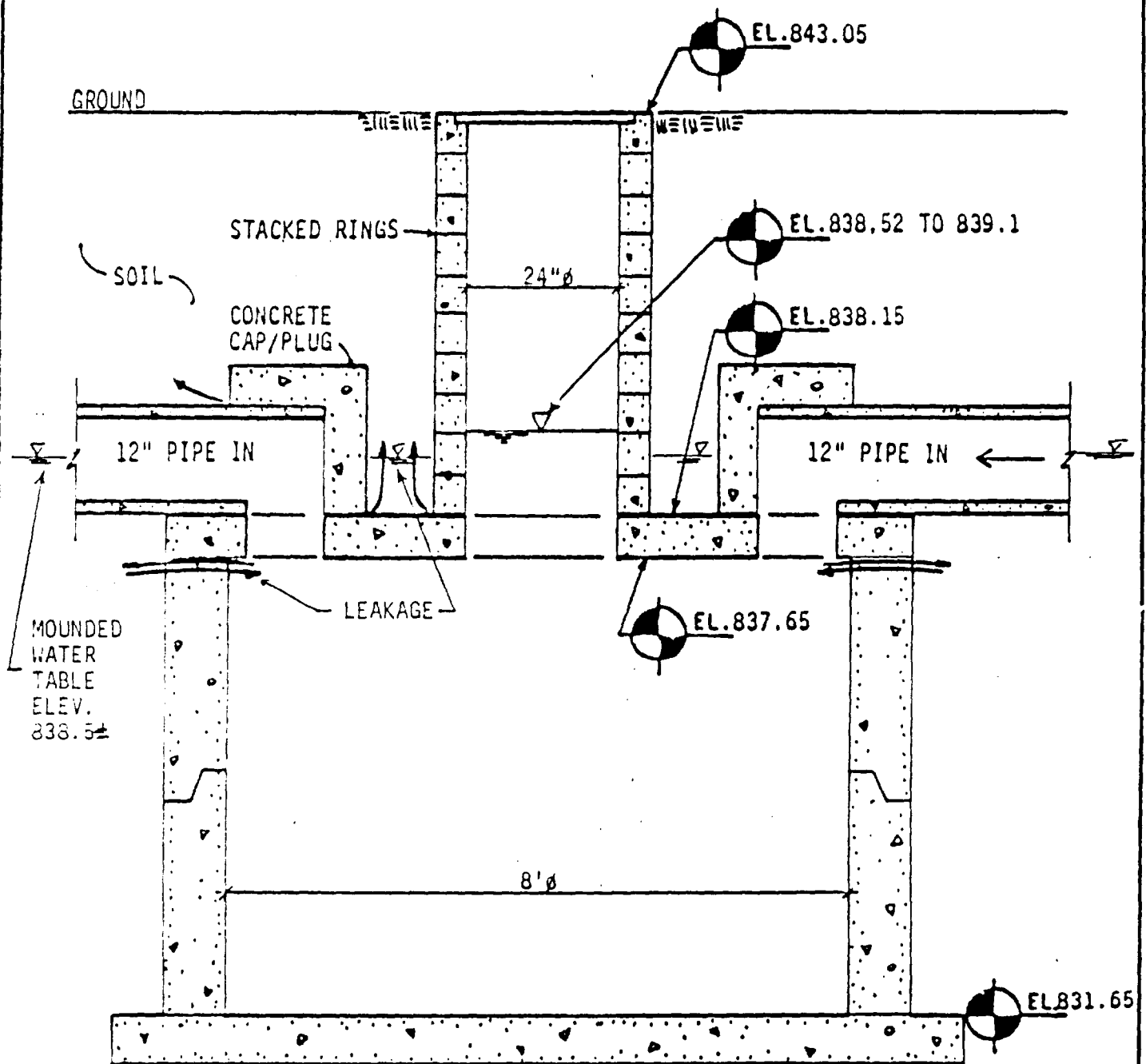


Figure 2
**Plan Showing Location of
 Borings, Wells and Cross Sections**
 Sundstrand Corporation
 Rockford, Illinois
 March, 1987 20557



SPILL CONTAINMENT SUMP



JAN. 7, 1985

FIGURE No. 2

SCALE: 1/2" = 1'-0"



FEHR, GRAHAM & ASSOCIATES

CONSULTING ENGINEERS

660 W. STEPHENSON ST., FREEPORT, ILLINOIS /

815/235-7643

B-5

B-6 LOCATED
10' EAST

GRAV.
MOUNDED WATER
TABLE BOUNDARY

Bldg.

Bldg.

SPILL
CONTAINMENT
SUMP
WB-17
WB-20
CONC.

TEST CELL
G-5

ELEC.
SUBSTATION

UNDERGROUND
ELECTRIC

B-7

CONC. PAD

PROP. PERFORATED
2" PVC PIPE
(10 L.F.)

B-2

WB-19

WB-18

WB-17

WB-16

WB-15

WB-14

WB-13

B-8

B-3

B-4

B-9

B-10

B-11

B-12

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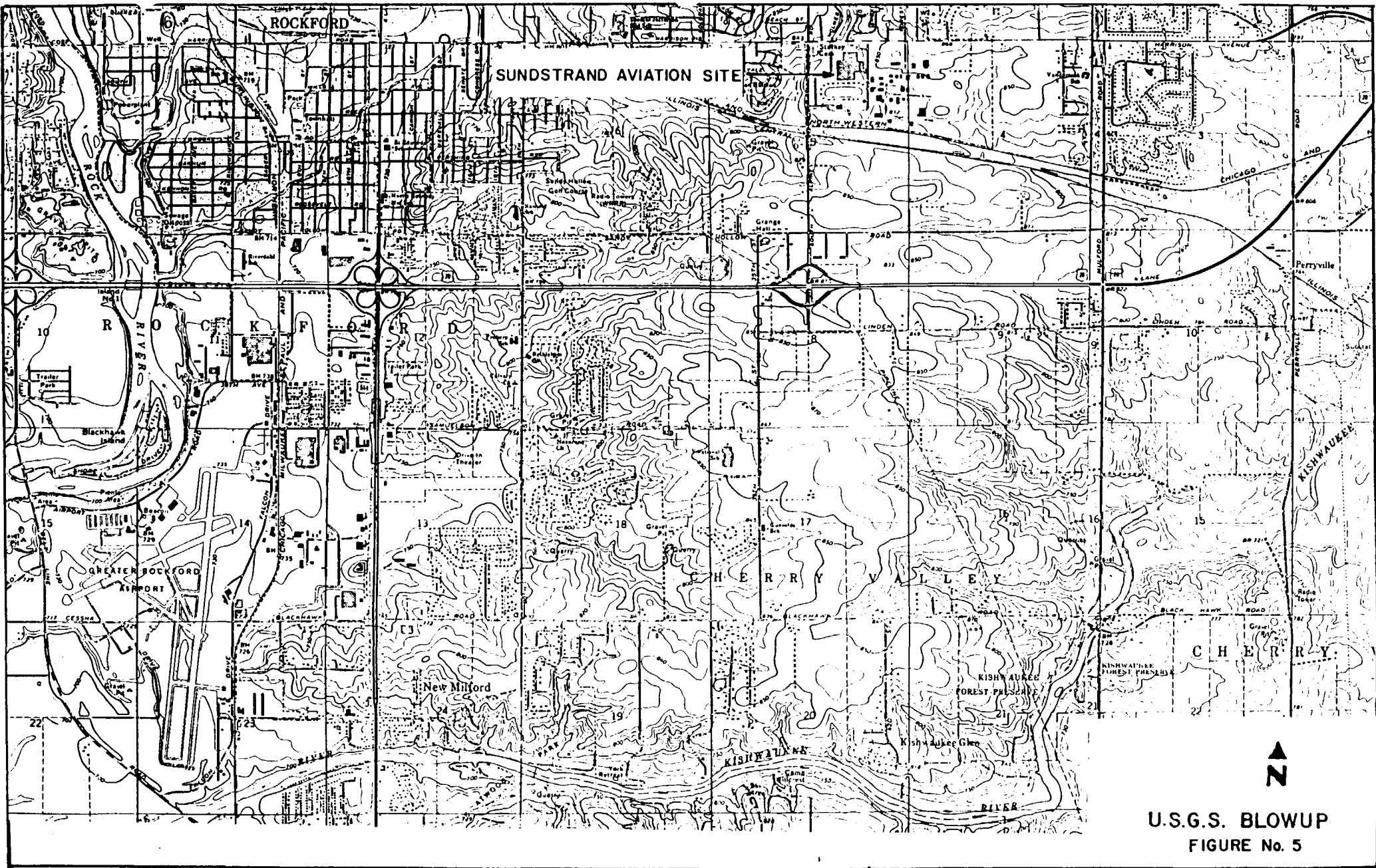
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B-335

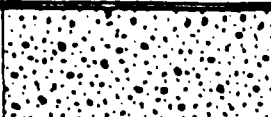

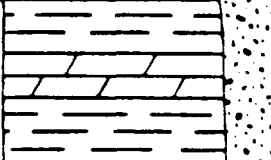
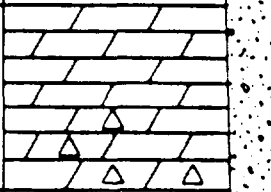
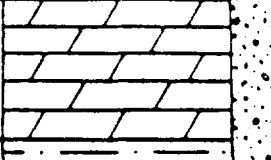

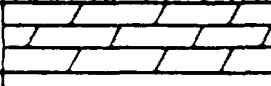
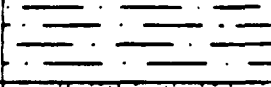
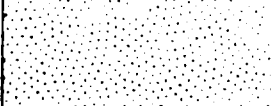
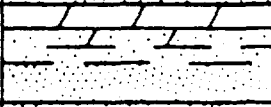


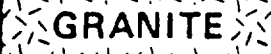
B-336

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B-338



U.S.G.S. BLOWUP
FIGURE No. 5

SYSTEM	GROUP	FORMATION & THICKNESS	GRAPHIC COLUMN
QUATER-NARY 0 - 0.7 m.y. B.P.		0 - 450 ft	
SILUR. 405 - 440 m.y. B.P.		50 ft	
ORDOVICIAN 440 - 490 m.y. B.P.	Maquoketa	150 - 200 ft	
	Galena	250 ft	
	Platteville	100 ft	
	Ancell	Glenwood 5 - 60 ft	
		St. Peter 200 - 400 ft	
CAMBRIAN 500 - 515 m.y. B.P.		Potosi 50 - 100 ft	
		Franconia 50 - 100 ft	
		Ironton - Galesville 75 - 170 ft	
		Eau Claire 350 - 450 ft	
		Mt. Simon 1000 - 1600 ft	
PRECAMBRIAN			 GRANITE

ISGS 1981

Figure 6 Stratigraphic column for Boone and Winnebago Counties (not to vertical scale).

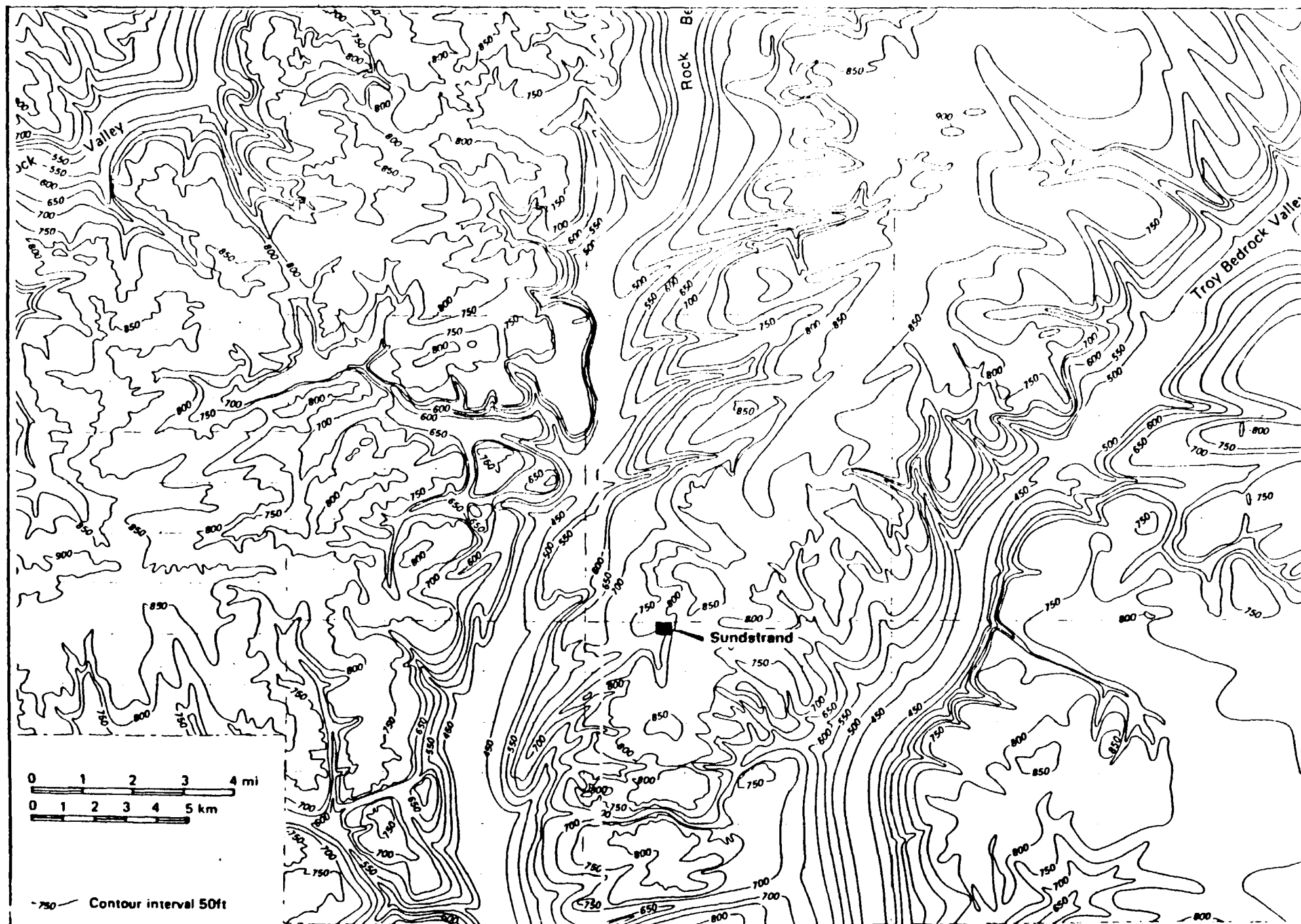
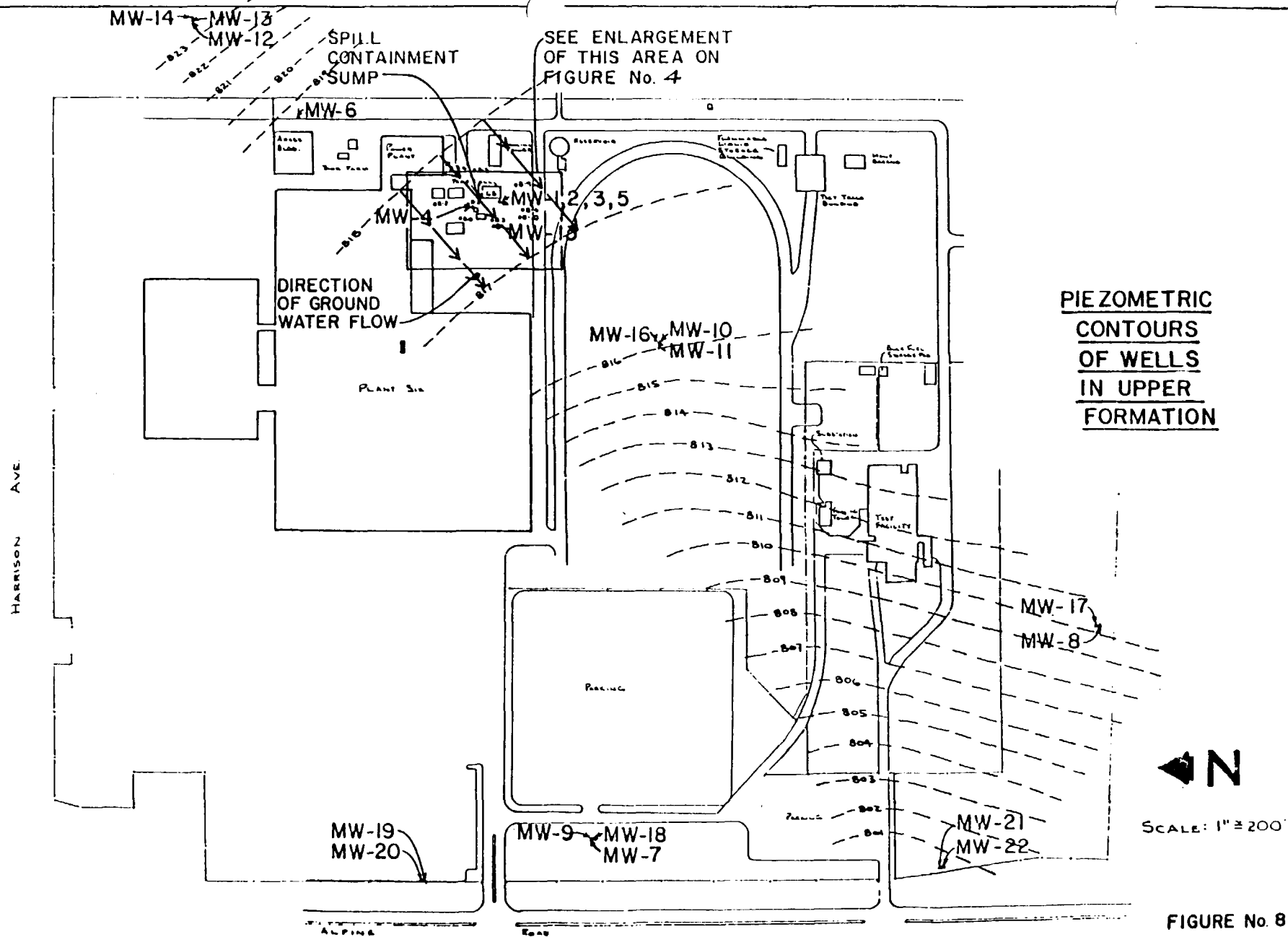
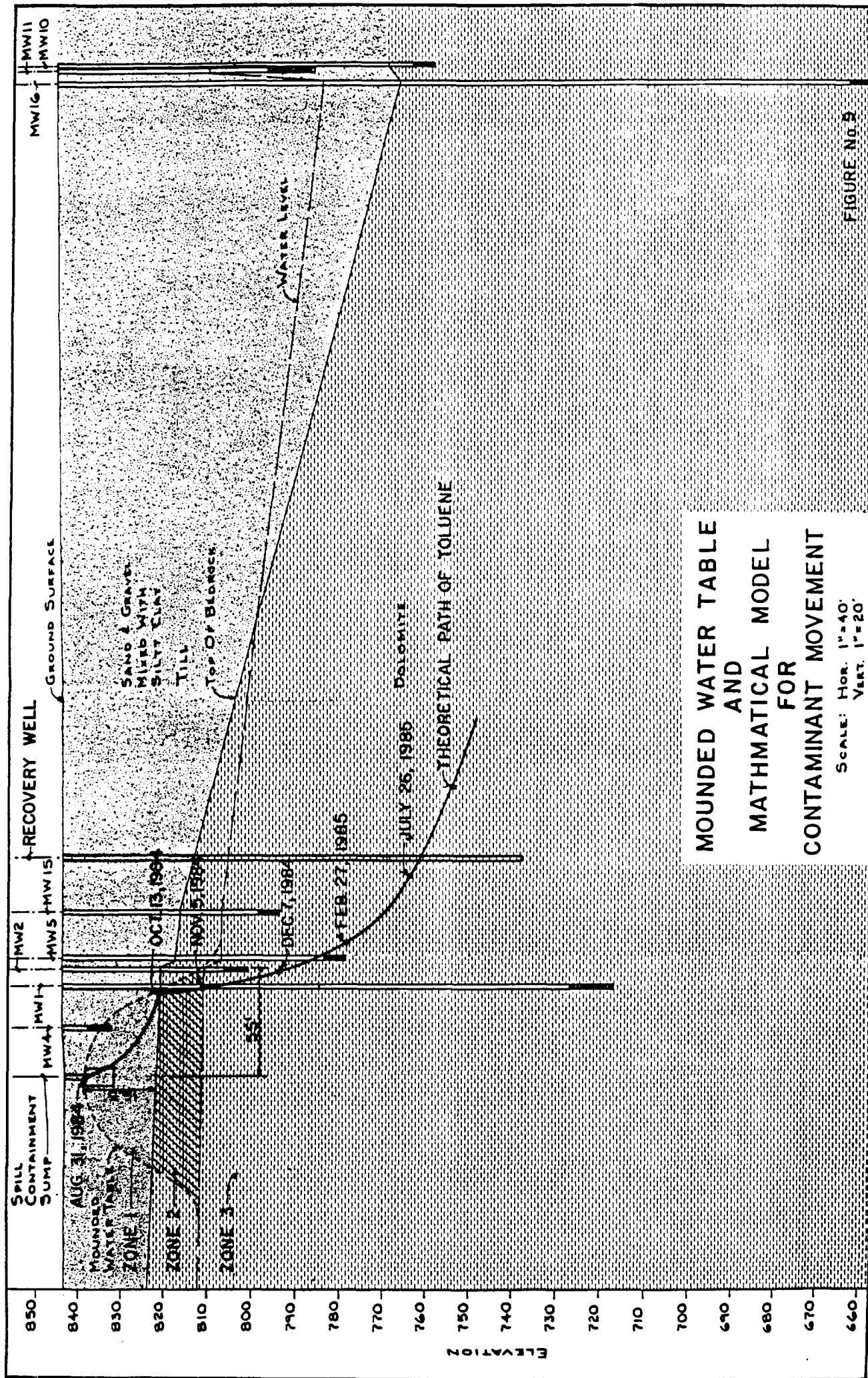


Figure 7 Topography of the Bedrock Surface



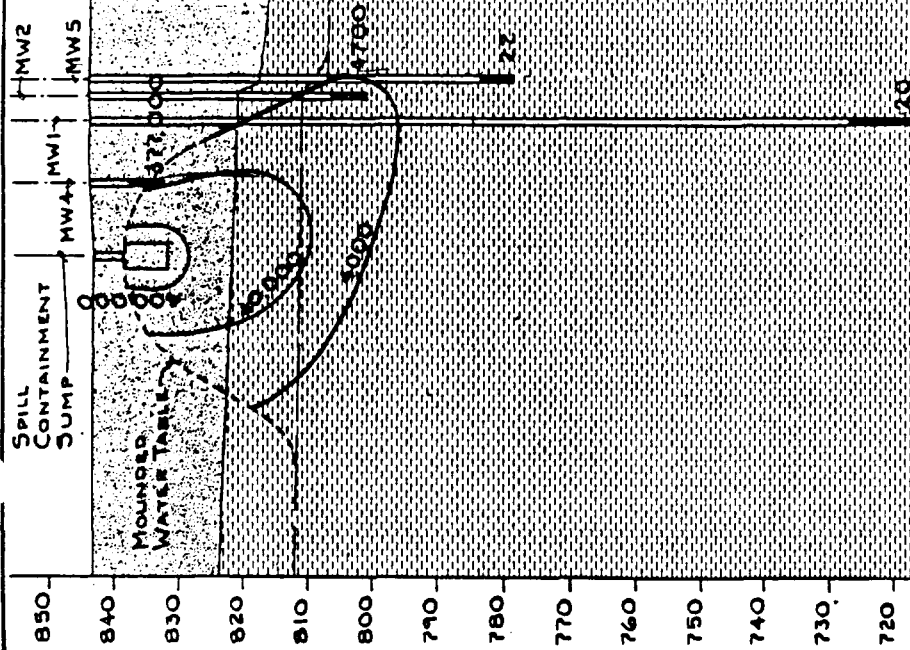


MOUNDED WATER TABLE
AND
MATHEMATICAL MODEL
FOR
CONTAMINANT MOVEMENT

SCALE: HOR. 1"=40'
VERT. 1"=20'

FIGURE No. 9

SPILL
CONTAINMENT
DUMP



GROUND SURFACE

SAND & GRAVEL
MIXED WITH
SILTY CLAY

三

Top Of Blarock

WATER LUTHER

Deleone

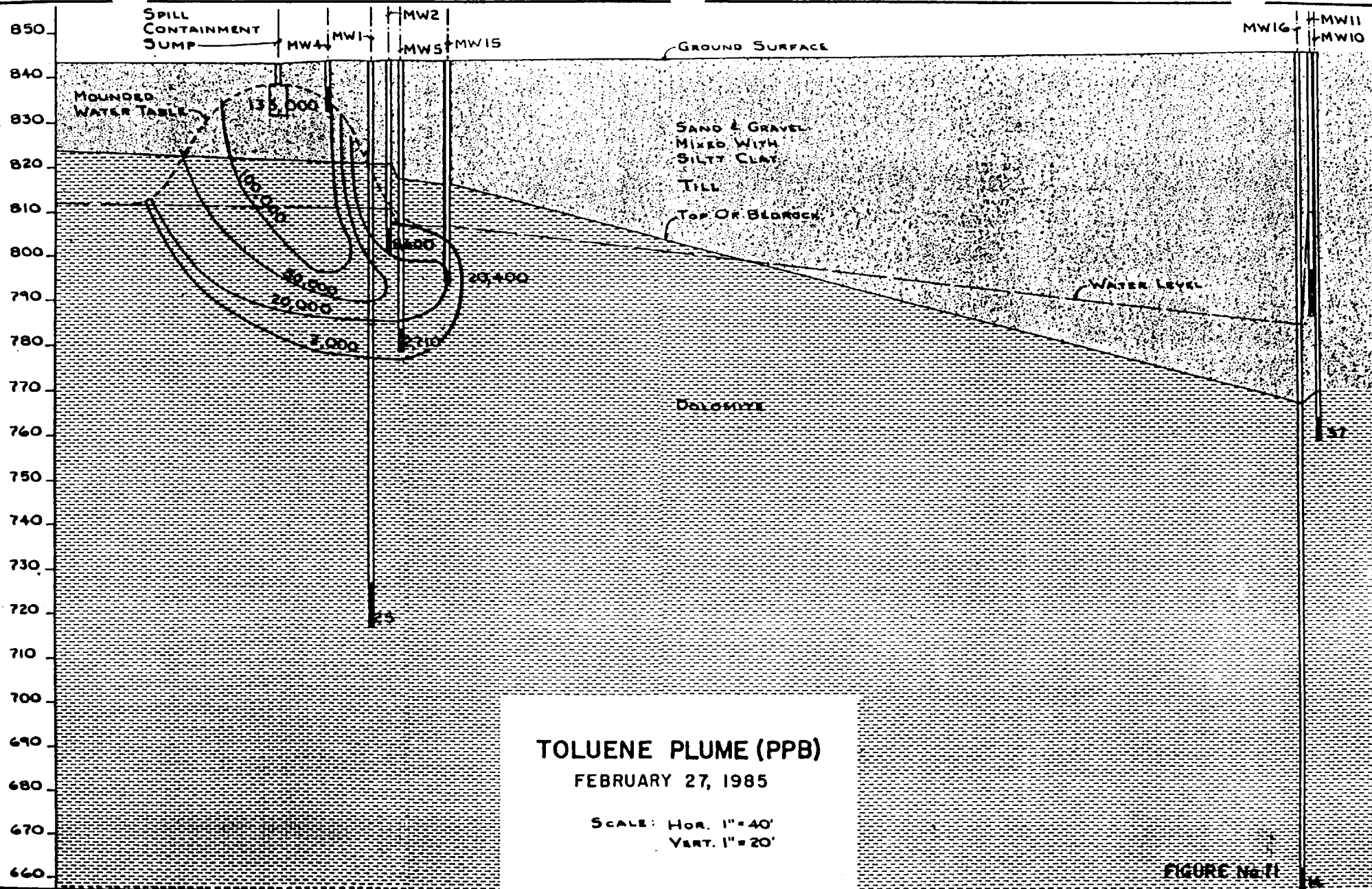
TOLUENE PLUME (PPB)

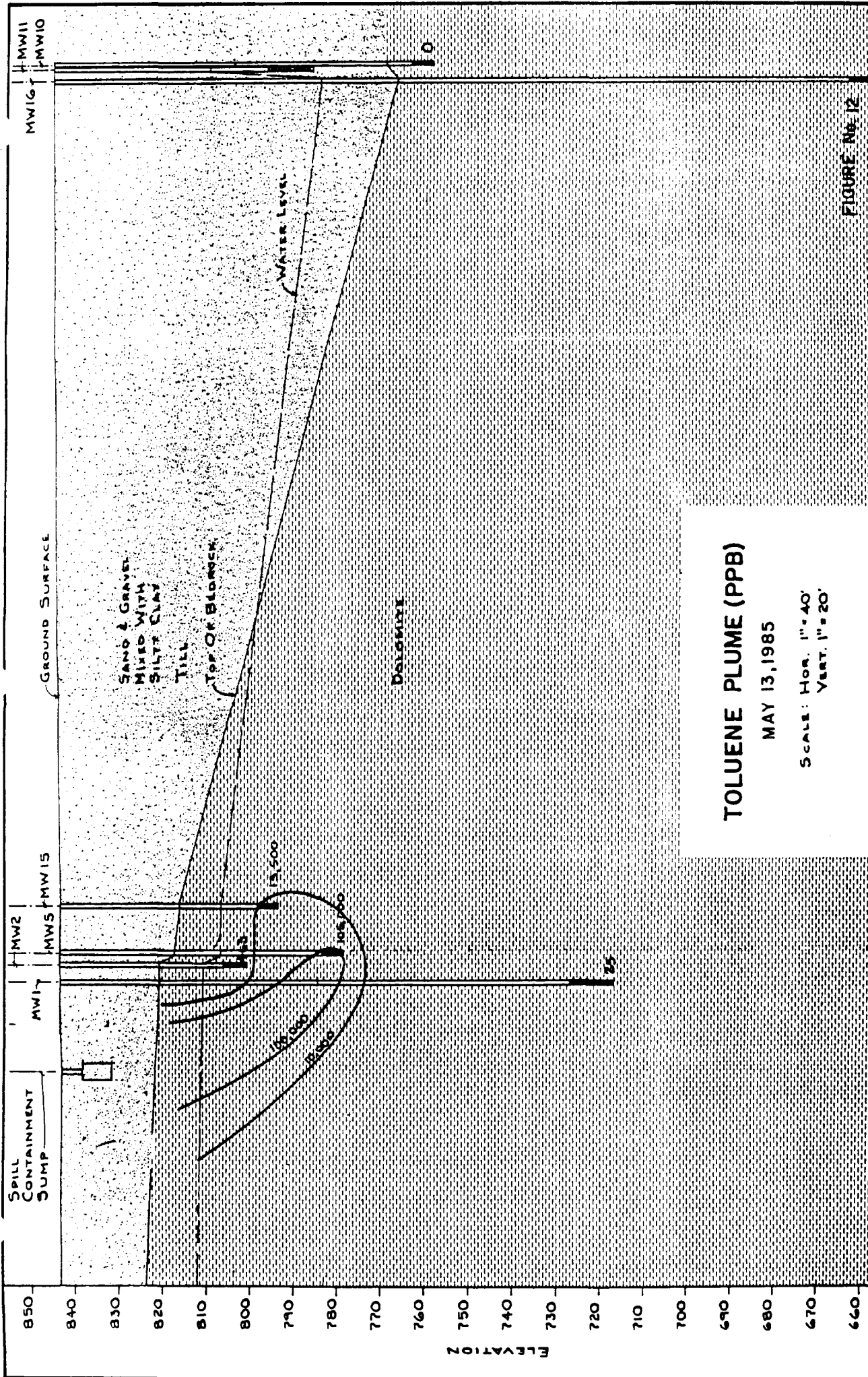
DECEMBER 7, 1984

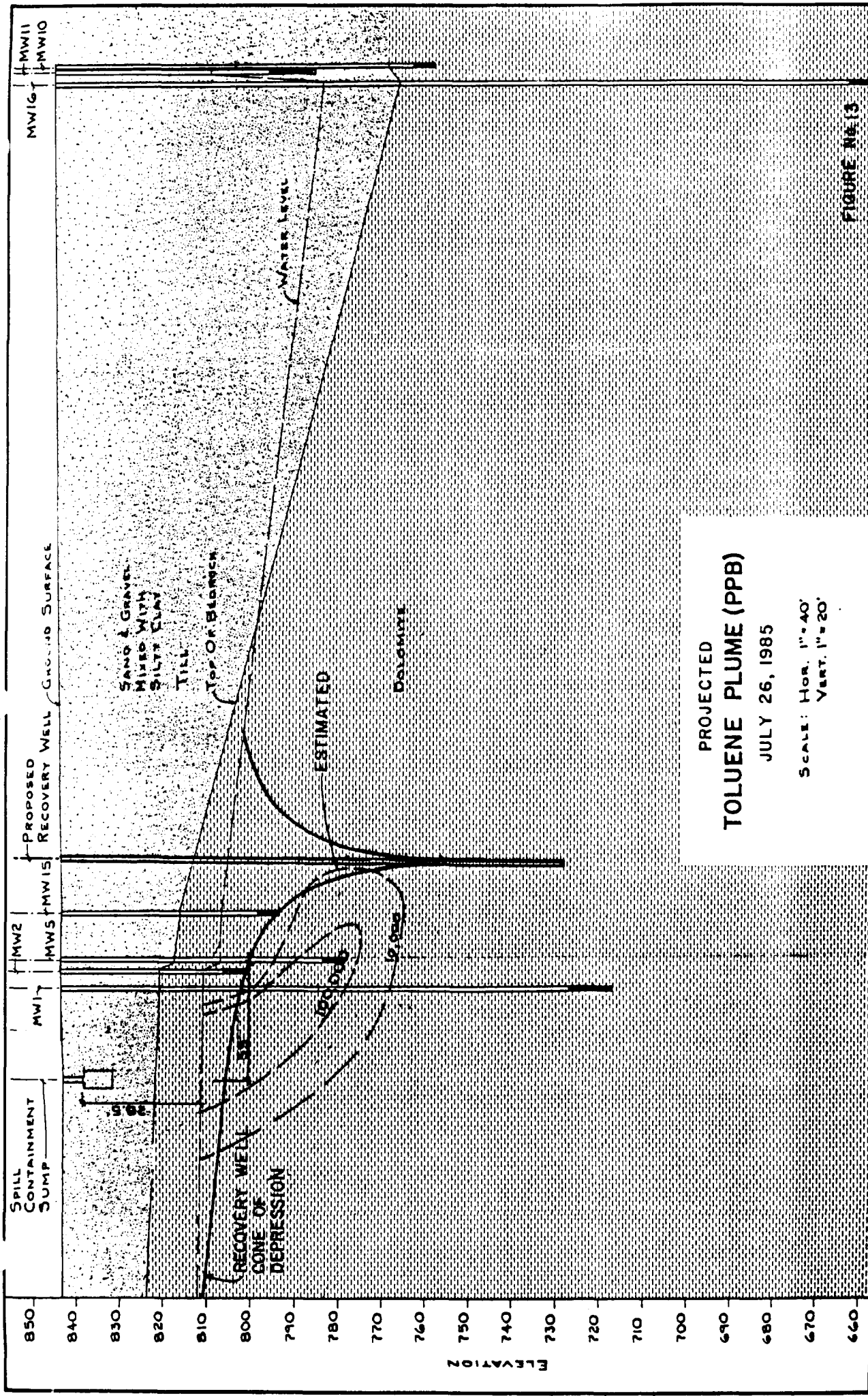
SCALE: HOR. 1" = 40'
VERT. 1" = 20'

FIGURE Na 10

ELEVATION





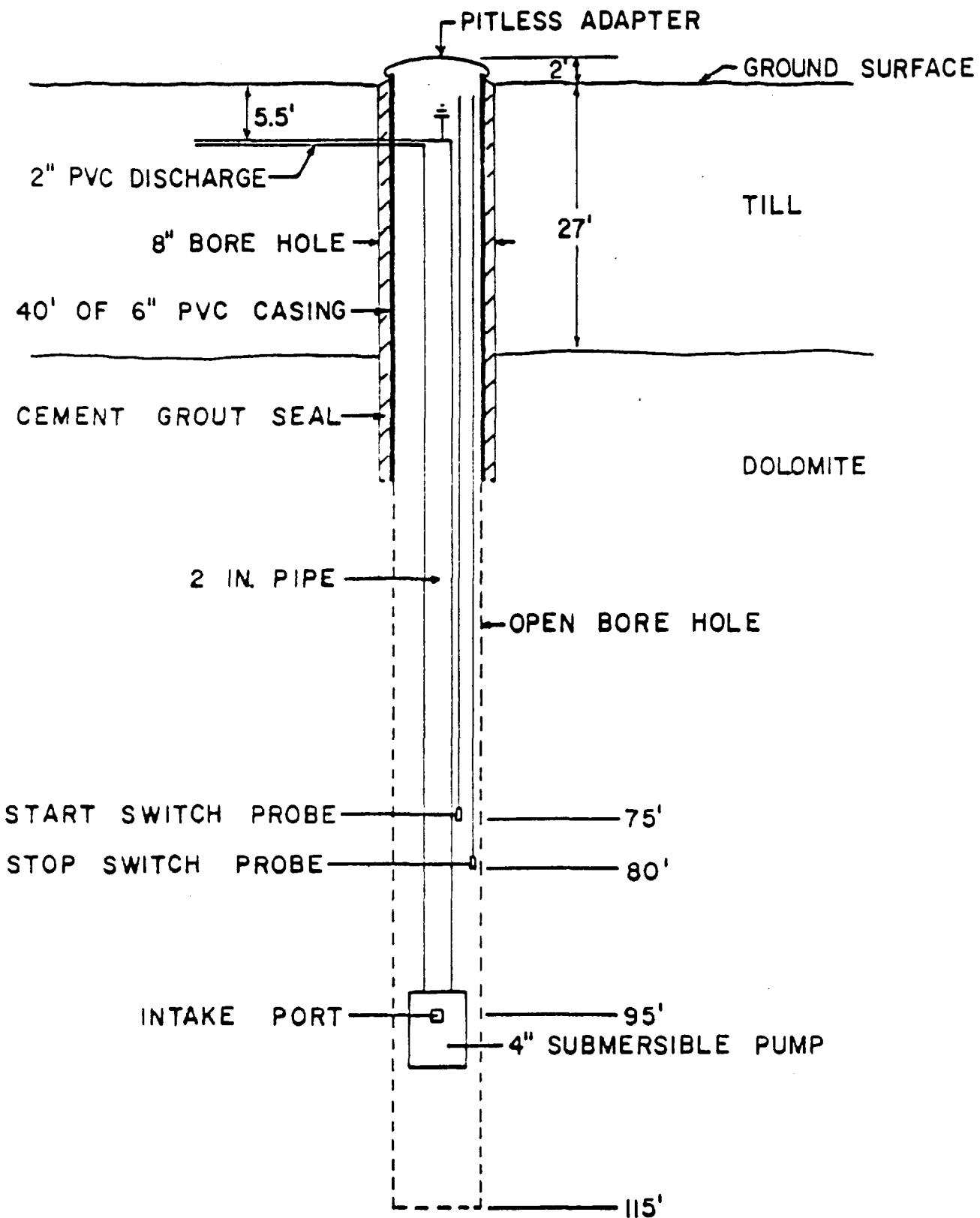


PROJECTED
TOLUENE PLUME (PPB)

JULY 26, 1985

SCALE: HOR. 1"=40'
VERT. 1"=20'

FIGURE No. 13



RECOVERY WELL DETAIL

ATTACHMENTS

- Soil Boring Toluene Results Attachment No. 1
- Slug Test Results and
Permeability Calculations..... Attachment No. 2
- Monitoring Well Logs and
Water Levels Attachment No. 3
- Laboratory Quality Control Attachment No. 4

ATTACHMENT NO. 1

SOIL BORING TOLUENE RESULTS

SUNDSTRAND AVIATION
Soil Sampling Summary

<u>Boring B-1 (12/5/84)</u>			<u>Boring B-2 (12/5/84)</u>			<u>Boring B-3 (12/5/84)</u>			<u>Boring B-4 (12/5/84)</u>			<u>Boring B-5 (12/5/84)</u>		
<u>Sample No.</u>	<u>Depth (ft.)</u>	<u>Toluene (ppb)</u>	<u>Sample No.</u>	<u>Depth (ft.)</u>	<u>Toluene (ppb)</u>	<u>Sample No.</u>	<u>Depth (ft.)</u>	<u>Toluene (ppb)</u>	<u>Sample No.</u>	<u>Depth (ft.)</u>	<u>Toluene (ppb)</u>	<u>Sample No.</u>	<u>Depth (ft.)</u>	<u>Toluene (ppb)</u>
S-1A	2-4	70												
S-2	4-6	740												
S-3A	6-7	270	S-1	4.5-6	7,200							S-1	4.5-6	< 40
S-3B	7-8	170												
S-4A	8-9	150												
S-4B	9-10	< 10												
S-5A	10-11	20,000	S-2	9.5-11	1,300	S-2	9.5-11	100	S-2	9.5-11	140	S-2	9.5-11	
S-5B	11-12	110										S-3	11-12.5	
S-6A	12-13	24,000										S-4	12.5-14	< 40
S-6B	13-14	920												
S-7A	14-15	7,700										S-5	14-15.5	< 40
S-7B	15-15.5	340												
S-8	23-25	340	S-4	19.5-21	130				S-5	23-24.5	100	S-6	19.5-21	< 40
						S-6	25-26.5	110						

SUNDSTRAND AVIATION
Soil Sampling Summary (contd)

<u>Boring B-6 (12/19/84)</u>			<u>Boring B-7 (12/19/84)</u>			<u>Boring B-8 (12/19/84)</u>			<u>Boring B-9 (12/20/84)</u>			<u>Boring B-10 (12/20/84)</u>		
<u>Sample No.</u>	<u>Depth (ft.)</u>	<u>Toluene (ppb)</u>	<u>Sample No.</u>	<u>Depth (ft.)</u>	<u>Toluene (ppb)</u>	<u>Sample No.</u>	<u>Depth (ft.)</u>	<u>Toluene (ppb)</u>	<u>Sample No.</u>	<u>Depth (ft.)</u>	<u>Toluene (ppb)</u>	<u>Sample No.</u>	<u>Depth (ft.)</u>	<u>Toluene (ppb)</u>
S-1	5-6.5	< 20	S-1	4-5.5	< 20	S-1	4-5.5	< 20	S-1	4-5.5	< 20	S-1	4-5.5	< 20
S-2	9.5-11	< 20	S-2	9-10.5	< 20	S-2	9-10.5	123	S-2	9-10.5	< 20	S-2	9-10.5	69
S-3	11-12.5	< 20	S-3	10.5-12	< 20	S-3	10.5-12	115	S-3	10.5-12	131	S-3	10.5-12	27
S-4	12.5-14	< 20	S-4	12-13.5	< 20	S-4	12-13.5	< 20	S-4	12-13.5	< 20	S-4	12-13.5	160
S-5	14-15.5	< 20	S-5	13.5-15	< 20	S-5	13.5-15	< 20	S-5	13.5-15	< 20	S-5	13.5-15	20
S-6	20-21.5	31	S-6	19-20.5	48	S-6	19-20.5	< 20	S-6	19-20.5	26	S-6	19-20.5	< 20

ATTACHMENT NO. 2

SLUG TEST RESULTS

AND

PERMEABILITY CALCULATIONS

SLUG TESTS
For
Sundstrand Aviation
Monitoring Wells

Slug Volume = 4 ft. X 1.66 inch. O.D. = 0.060 ft³
= 0.450 Gal.

<u>Water Level</u>		<u>Hr.</u>	<u>Time</u> <u>Min.</u>	<u>Sec.</u>
MW-1				
40.17	Static			
39.14	Slug Inserted	0	0	0
39.94		0	1	40
40.03		0	3	55
40.10		0	14	10
MW-5				
38.35	Static			
35.63	Slug inserted	0	0	0
36.55		0	0	25
37.07		0	1	00
37.32		0	1	22
37.57		0	1	45
37.82		0	2	26
38.07		0	3	26
38.32		0	6	00

Total Depth MW-1 = 129.19 ft.
Total Depth MW-5 = 67.52 ft.

March 8, 1985

Fehr, Graham and Associates

SLUG TESTS
For
Sundstrand Aviation
Monitoring Wells

Slug Volume = 4 ft. x 1.75 inch O.D. = 0.066 ft³
= 0.497 Gal.

	<u>Water Level</u>	<u>Hr.</u>	<u>Time</u> <u>Min.</u>	<u>Sec.</u>
MW-2	34.08 Static			
	31.18 Slug Inserted	0	0	0
	31.43		5	29
	31.68		10	20
	31.93		16	13
	32.18		23	40
*MW-4	8.15 Static			
	7.70 Slug Inserted	0	0	0
	7.95		1	52
MW-9	36.97 Static			
	34.17 Slug Inserted	0	0	0
	34.42		**	
	34.67		1	0
	34.92		1	30
	35.17		2	20
	35.42		3	06
	35.67		4	04
	35.92		5	33
	36.17		7	19
*MW-10	43.47 Static			
	42.95 Slug Inserted	0	0	0
	43.20		0	25
	43.45		1	20

* Very Quick Recovery (fully recovered)

** Unable to accomplish first reading

January 7, 1985

Fehr, Graham and Associates

SLUG TESTS
For
Sundstrand Aviation
Monitoring Wells

Slug Volume = 4 ft. x 1.66 inch O.D. = 0.060 ft³
= 0.450 Gal.

<u>Water Level</u>		<u>Hr.</u>	<u>Time</u> <u>Min.</u>	<u>Sec.</u>
MW-6				
29.11	Static			
26.76	Slug Inserted	0	0	0
27.01			3	45
27.26			8	19
27.51			14	53
27.76			24	06
28.01			35	09
28.26			51	40
28.77		1	48	15
MW-7				
26.73	Static			
24.72	Slug Inserted	0	0	0
24.97			0	47
25.22			1	36
25.47			2	54
25.72			3	54
25.97			6	14
26.22			10	04
26.47			14	55

Total Depth MW-6 = 39.82
Total Depth MW-7 = 32.97

December 20, 1984

Fehr, Graham and Associates,

SLUG TESTS
For
Sundstrand Aviation
Monitoring Wells

Slug Volume = 4 ft. X 1.66 inch. O.D. = 0.060 ft³
= 0.450 Gal.

<u>Water Level</u>		<u>Hr.</u>	<u>Time</u> <u>Min.</u>	<u>Sec.</u>
MW-8				
7.99	Static			
5.57	Slug Inserted	0	0	0
5.80		0	0	35
5.89		0	0	53
6.14		0	1	51
6.39		0	2	32
6.64		0	3	45
6.89		0	5	10
7.14		0	7	12
7.39		0	10	35
7.64		0	15	04
7.89		0	24	30

Total Depth MW-8 = 21.11 ft.

March 8, 1985

Fehr, Graham and Associates

SLUG TESTS
For
Sundstrand Aviation
Monitoring Wells

Slug Volume = 4 ft. X 1.66 inch. O.D. = 0.060 ft³
= 0.450 Gal.

<u>Water Level</u>		<u>Hr.</u>	<u>Time</u> <u>Min.</u>	<u>Sec.</u>
MW-13				
39.29	Static			
37.55	Slug Inserted	0	0	0
37.80		0	1	35
38.05		0	2	35
38.30		0	3	40
38.55		0	5	45
38.80		0	7	40
39.05		0	12	54

• Total Depth MW-13 = 67.65 ft.

March 8, 1935

Fehr, Graham and Associates

SLUG TESTS
For
Sundstrand Aviation
Monitoring Wells

Slug Volume = 4 ft. X 1.66 inch. O.D. = 0.060 ft³
= 0.450 Gal.

MW-14	<u>Water Level</u>	<u>Time</u>		
		<u>Hr.</u>	<u>Min.</u>	<u>Sec.</u>
	39.54 Static			
	36.94 Slug Inserted	0	0	0
	37.55	0	0	41
	37.94	0	1	16
	38.19	0	2	00
	38.44	0	2	57
	38.69	0	4	29
	38.94	0	7	05
	39.19	0	12	20
	39.44	0	31	00

Total Depth MW-14 = 102.80 ft.

March 8, 1985

Fehr, Graham and Associates

SLUG TESTS
For
Sundstrand Aviation
Monitoring Wells

Slug Volume = 4 ft. X 1.66 inch. O.D. = 0.060 ft³
= 0.450 Gal.

<u>Water Level</u>		<u>Time</u>		
		<u>Hr.</u>	<u>Min.</u>	<u>Sec.</u>
MW-15				
38.15	Static			
35.30	Slug Inserted	0	0	0
35.46		0	1	18
35.57		0	2	18
35.69		0	3	30
35.72		0	4	30
36.00		0	7	00
36.19		0	10	30
36.53		0	15	30
37.01		0	20	50
37.16		0	26	30
37.23		0	31	45
37.43		0	37	00
37.57		0	42	00

Total Depth MW-15 = 52.11 ft.

March 8, 1985

Fehr, Graham and Associates

SLUG TESTS
For
Sundstrand Aviation
Monitoring Wells

Slug Volume = 4 ft. X 1.66 inch. O.D. = 0.060 ft³
= 0.450 Gal.

<u>Water Level</u>		<u>Hr.</u>	<u>Time</u> <u>Min.</u>	<u>Sec.</u>
MW-16				
43.03	Static			
41.52	Slug Inserted	0	0	0
42.59		0	0	20
42.87		0	1	00
43.03		0	1	40

• Total Depth MW-16 = 202.56 ft.

March 8, 1985

Fehr, Graham and Associates

PERMEABILITY CALCULATIONS

Permeability is calculated as:

$$K = \frac{r^2 \ln(L/R)}{2 \times L \times T_0}$$

where

K = Permeability (ft/sec)

r = Standpipe radius (ft)

R = Radius of screen and gravel pack (ft)

L = Length of screen and gravel pack (ft)

T_0 = Basic time lag (sec), where T_0 is the elapsed time at which

$$\frac{H-h}{H-H_0} = 0.37, \text{ and}$$

H = head at $t < 0$ (ft)

H_0 = head at $t = 0$ (ft)

h = head at any other time (ft)

EXAMPLE CALCULATION

Well: MW-5, Tested March 8, 1985

L = 9.1 ft H = 38.35 ft

r = 0.084 ft $H_0 = 35.60$ ft

R = 0.17 ft Falling Head Test

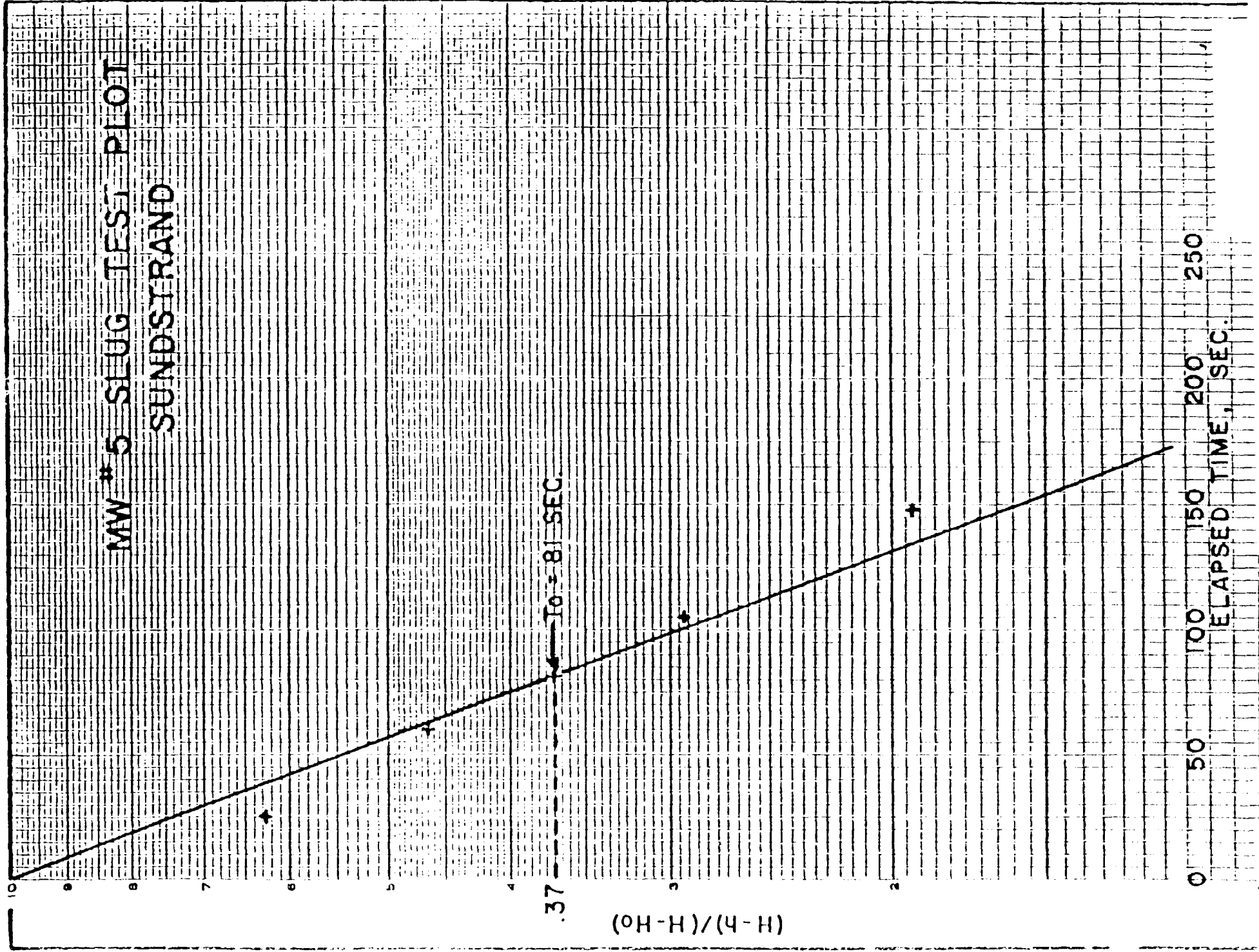
Field Data

Elapsed Time (sec)	h (ft)	$\frac{H-h}{H-H_0}$
< 0	38.35	--
0	35.60	1.00
25	36.55	0.65
60	37.07	0.47
82	37.32	0.37
105	37.57	0.28
146	37.82	0.19
206	38.07	0.10
360	38.32	0.01

From plot, $T_0 = 81$ sec (See following page)

$$K = \frac{(0.084)^2 \ln(9.1/0.17)}{(2) (9.1) (81)} = 1.9 \times 10^{-5} \text{ ft/sec}$$

MW # 5 SLUG TEST PLOT SUNDSTRAND



The preceeding calculation provides the following results:

MW#	Material	Depth(Ft.)	Permeability (Ft/sec)
1	Dolomite	126.6	1.1×10^{-6}
2	Fractured Dolomite	42.5	6.1×10^{-7}
4	Till	11.4	4.0×10^{-5}
5	Dolomite	65.1	1.9×10^{-5}
6	Fractured Dolomite	38.0	4.7×10^{-7}
7	Till	30.6	4.4×10^{-6}
8	Till	19.0	4.1×10^{-6}
9	Fractured Dolomite	52.5	6.0×10^{-6}
10	Dolomite	87.4	9.3×10^{-5}
13	Dolomite	65.6	1.0×10^{-5}
14	Dolomite	100.6	9.0×10^{-6}
15	Dolomite	50.0	1.2×10^{-6}
16	Dolomite	200.6	2.5×10^{-4}

The geometric mean of the permeability in the dolomite formation is 6.0×10^{-6} feet per second.

ATTACHMENT NO. 3
MONITORING WELL LOGS
AND
WATER LEVELS

DRILLING RECORDDate Oct 30, 1984Boring Number MW

Driller

Water Table Information

Bob Wulf

SAMPLING RECORD				LOG	
Sample Recovery	Sample Number	Sample Depth	Blow Count	Depth	Description
16"	1	2 - 4'	3-2-2-4	0-2'	fill of coarse sand and
18"	2	4 - 6'	1-1-1-1		gravel, wet
20"	3	6 - 8'	3-3-4-4	2-4 1/2'	loose brown sand with some
20"	4	8 - 10'	1-1-0-5		gravel, clayey binder, wet
24"	5	10 - 12'	5-3-4-8	4 1/2'-6 1/2'	Very loose brown sand with
24"	6	12 - 14'	6-10-14-24		some gravel and some clay,
18"	7	14 - 16'	15-34-68	6 1/2'-9'	Firm brown clayey silt, so
	8*				sand, moist
				9-11' 10"	Loose brown sand and gra
					wet
				11' 10"-15'	Dense brown clayey silt
					with some sand and gravel,
					damp.
				*15 1/2'	Boulder at 15 feet. Drill
					was convinced it was bedrock
					and switched to rock-corin
					tool. Bedrock was not
					encountered until 25'
Logging Geologist					
Peter J. Vagt					
5/20/84					

DRILLING RECORD

Date 10/31/85

Boring Number MW-1
(Continued)

Driller

Water Table Information

Bob Wolf

[illegible]

DRILLING RECORD

Date 11/5/85

Boring Number MW-2

Driller

Water Table Information

Bob Wolf

[illegible]

DRILLING RECORD

Date 11/5/85

Boring Number MW-3

Driller

Water Table Information

Bob Wolf

[illegible]

DRILLING RECORD

Date 12/3/84

Boring Number MW-

Driller

Bob Wolf

Water Table Information

Water Level about 10'

[illegible]

DRILLING RECORD

Date 12/3/84

Boring Number MW-

Driller

Water Table Information

Bob Wolf

[illegible]

DRILLING RECORD

Date 12/4/84

Boring Number MW-6

Driller

Water Table Information

Bob Wolf

[illegible]

DRILLING RECORD

Date 12/4/84

Boring Number MW-7

Driller

Bob Wolf

Water Table Information

SAMPLING RECORD				LOG	
Sample Recovery	Sample Number	Sample Depth	Blow Count	Depth	Description
	5-1	1½-3	7-20-28	1½-3	Sandy silty gravel very dry
18"	5-2	3-4½	21-41-54	3-4½	Sandy silty stone very dry
18"	5-3	4½-6	(4½") 31-54-46	4½-6	Sandy silty stone very dry
12"	5-4	6-7	30-71	6-7	Sandy silty stone very dry
18"	5-5	9½-11	26-40-46	9½-11	Sandy silty stone dry
18"	5-6	12-13½	24-35-65	12-13½	Sandy silty stone moist
18"	5-7	14½-16	33-55-45 ^(4")	14½-16	Sandy silty stone dry
10"	5-8	19½-20½	45-55 (4")	19½-20½	Sandy silty sone dry
					Hit water about 28'
				12/5	Set well at 30 1/3' (5 foot screen) Added gravel to 25'
					Added bentonite pellets to 24'
					Cement slurry to top.

Logging Geologist Ken Beach

DRILLING RECORD

Date 12/5/84

Boring Number MW-

Driller

Water Table Information

Bob Wolf

SAMPLING RECORD				LOG	
Sample Recovery	Sample Number	Sample Depth	Blow Count	Depth	Description
12"	S-1	1½-3	3-3-5	1½-3	Sandy silty loam moist
10"	S-2	3-4½	3-3-4	3-4½	Sandy clay moist
17"	S-3A	4½-6 4½-4 3/4	4-6-8	4½-4 3/4	Sandy clay very moist
14"	S-3B	4 3/4-6		4 3/4-6	Black silty loam very moist
10"	S-4A	6-7½ 6-7	3-3-4	6-7	Black silty loam very moist
	S-4B	7-7½		7-7½	Sandy clay very moist
11"	S-5	7½-9	3-4-6	7½-9	Fine silty clay very moist
15"	S-6	9-10½	4-4-6	9-10½	Fine silty clay moist
8"	S-7A	10½-12 10½-11½	7-12-11	10½-11½	Fine silty clay moist
	S-7B	11½-12	11-9-7	11½-12	Sandy fine silt very moist
2"	S-8	12-13½	11-9-7	12-13½	Fine silt moist
16"	S-9A	13½-15 13½-14	4-8-12	13½-14	Fine silt very moist
	S-9B	14-15		14-15	Sandy silt wet
18"	S-10	15-16½	9-11-17	15-16½	Sandy silt very wet
18"	S-11A	16½-18 16½-17½	13-22-18	16½-17½	Sandy silt gravel very wet
	S-11B	17½-18		17½-18	Silt & stone very moist
18"	S-12	18-19½	12-20-30	18-19½	Hard sandy-gravel silt moist
					Set bottom of well at
					19'. 5' screen
Logging Geologist					Gravel to 12'. 1' of , bentinite pellets
					Portland cement slurry to surface
Ken Beach					

DRILLING RECORD

Date 12/27/84

Boring Number MW-6

Driller D&G
New Lennox

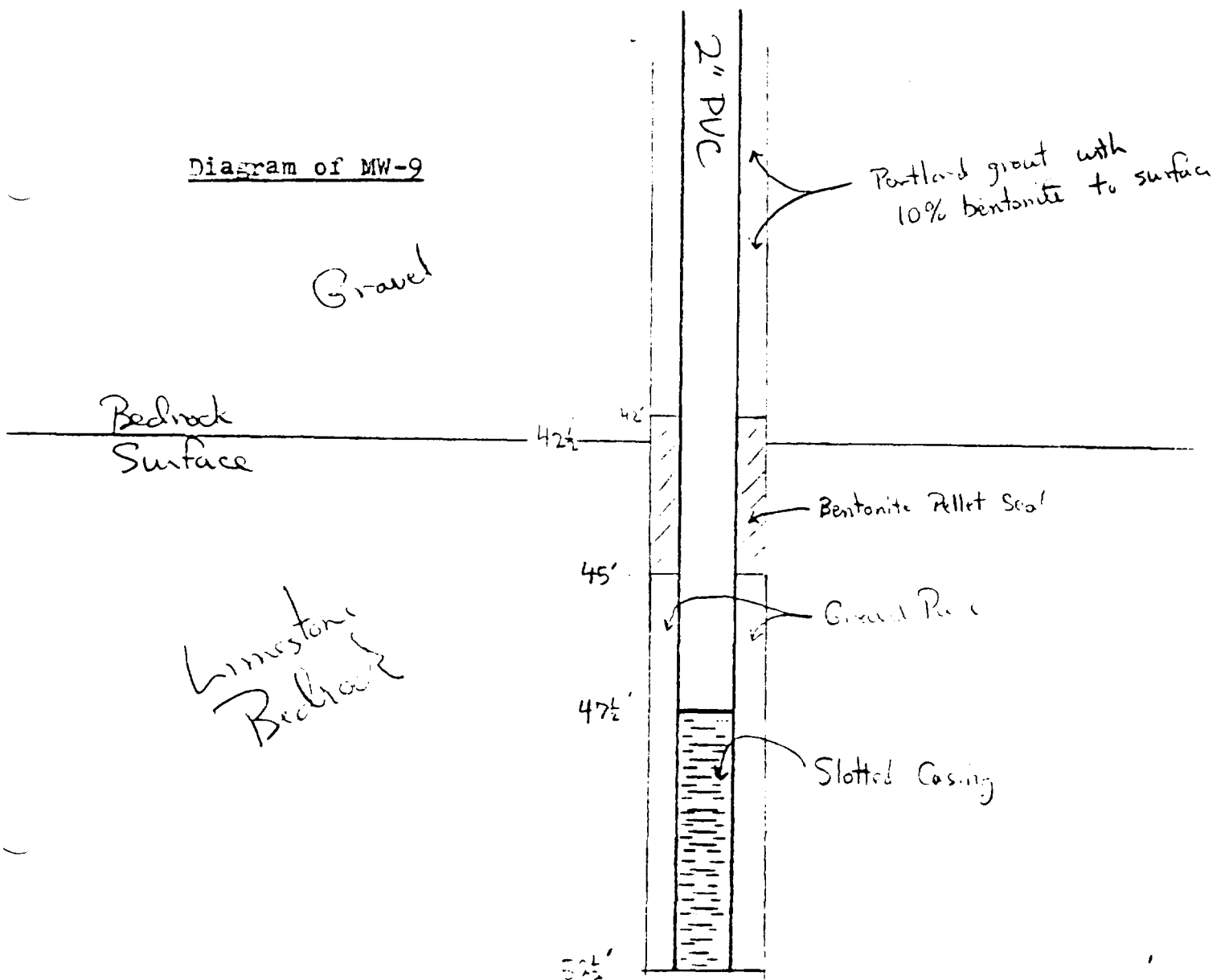
Water Table Information

[illegible]

MONITORING WELL NOTES

MW - 9

1. Bore hole made by wash and rotary bit with bentonite mud to depth of $52\frac{1}{2}$ feet.
2. Bottom of 5-foot long, 2-inch diameter PVC screen was set at $52\frac{1}{2}$ feet.
3. Gravel pack was placed from bottom to 45 feet.
4. Bentonite Pellet seal was placed from 45-42 feet.
5. Portland cement grout with 10% bentonite mixture was placed from 42 feet to surface.
6. Steel protective pipe was concreted into place over the well casing.

Diagram of MW-9

DRILLING RECORD

Date 12/20/84

Boring Number MW-1

Driller

Barry
John
(D & G Drilling)

Water Table Information

A little water at 11'
came into hole.
21½ feet water is setting

SAMPLING RECORD				LOG	
Sample Recovery	Sample Number	Sample Depth	Blow Count	Depth	Description
13"	S-1	4½-6	10-14-16	4½-6	Silty sandy rocky moist
15"	S-2	9½-11	14-17-33	9½-11	Silty sandy rocky moist
18"	S-3	14½-16	23-36-65	14½-16	Silty sandy rocky moist
12"	S-4	19½-21	44-52-50 ^(1")	19½-21	Silty sandy rocky moist
15"	S-5	24½-26	30-44-80	24½-26	Silty sandy rocky moist
6"	S-6	28½-29	100 (6")	28½-29	Silty sandy rocky moist
18"	S-7	33½-35	13-17-20	33½-35	Silty sandy rock very moist
4"	S-8	38½-39	100 (6")	38½-39	Gravel & rock wet
				43'	Hit a rock (changed to a 3" rock bit)
					Went back to a 4" bit and went down to
15"	S-9	48½-50	42-55-50 ^(1")	48½-50	Sand gravel & rock very wet
15"	S-10	53½-55	24-31-32	53½-55	Sand & silt very wet
15"	S-11	58½-60	31-44-48	58½-60	Sand & gravel very wet
18"	S-12A	63½-64½	77-43-17	63½-64½	Sand & Gravel very wet
	S-12B	64½-65		64½-65	Silty (clay?) very wet
17"	S-13	68½-70	17-18-56	68½-70	Sand & gravel very wet
					Boulders down to
					77'. Hit very fractured
					rock. Many voids. Set well
0072-SADM-MW-10	Drilling Mud				at 87' from ground. 5' screen 17' pea gravel 3' bentonite pellets. Portland cement slurry to surface.
Logging Geologist					
Ken Beach					

DRILLING RECORD

Date 12/21/84

Boring Number MW-1

Driller

Barry
John
(D & G Drilling)

Water Table Information

[illegible]

DATE: 21/01/2005

Date 12/27/84 begun
12/28/84 completed

Boring Number MW-12

Driller D & G
New Lennox

Water Table Information

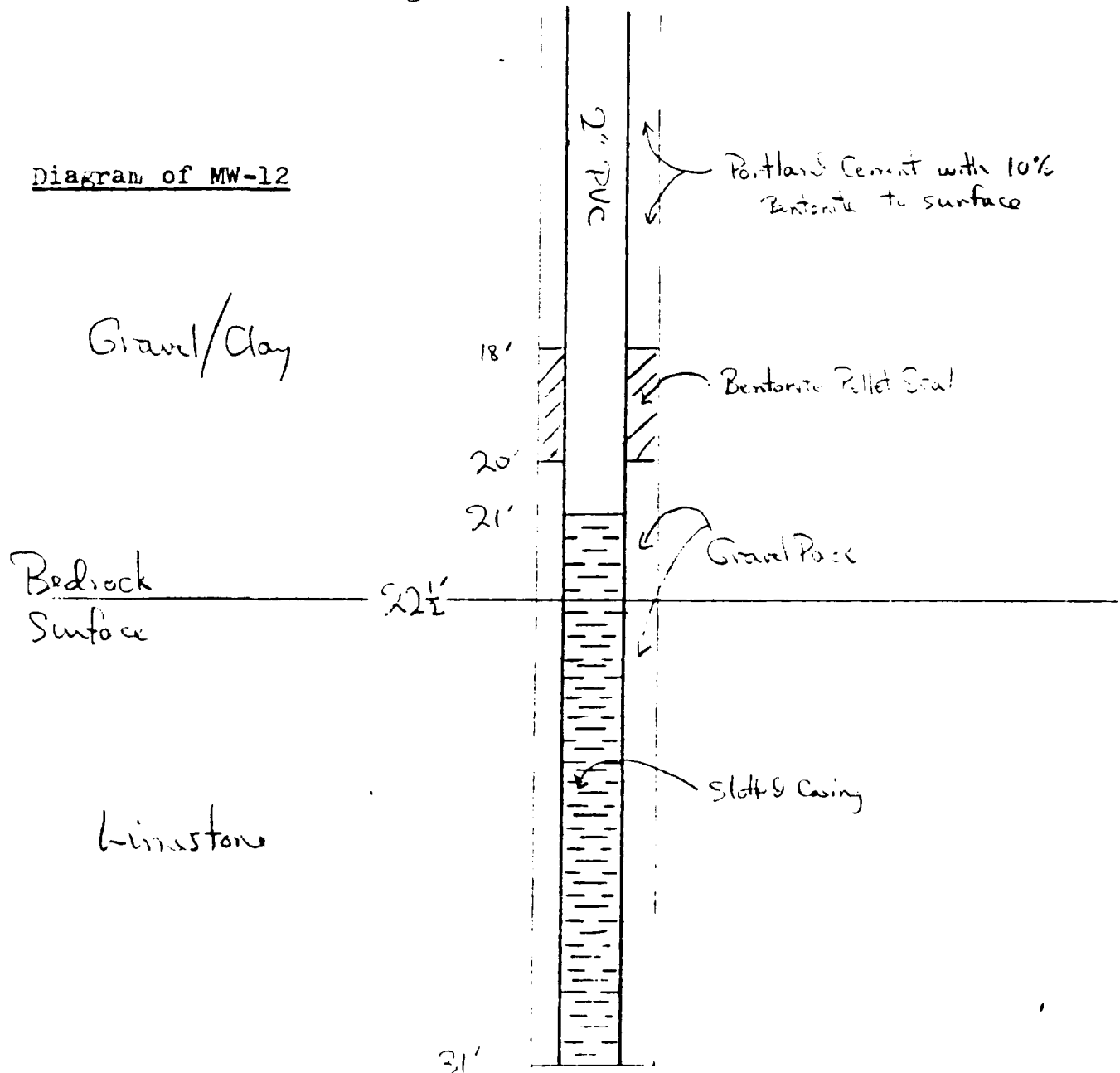
[illegible]

MONITORING WELL NOTES

MW - 12

1. Bore hole was made by rotary bit with a wash of bentonite mud to depth of 31 feet.
2. Bottom of 10-foot long, 2-inch diameter PVC screen was set at 31 feet.
3. Gravel pack was placed from bottom of casing to 20 feet below ground surface.
4. Bentonite pellet seal was placed between 18 and 20 feet.
5. Portland cement grout with 10% bentonite mixture was placed from 18 feet to the ground surface.
6. Steel protective pipe was concreted into place over the well casing.

Diagram of MW-12



DRILLING RECORD

Date 2/7/85

Boring Number MW-1

Driller

Water Table Information

Bob Wolf

[illegible]

DRILLING RECORDDate 2/11-13/85Boring Number MW-1

Driller

Bob Wolf

Water Table Information

SAMPLING RECORD				LOG	
Sample Recovery	Sample Number	Sample Depth	Blow Count	Depth	Description
				23'	Soil description same as MW-Hit rock very
					fractured to 30'
				100'	Drilled to 100'
					Installed five
					foot screen on 2"
					PVC well casing. Added
					gravel to 93'. Added
					1' of bentonite pellets
					to 92'. Formed a
					bentonite-Portland
					cement slurry and
					brought up to 4',
					by forcing to
					bottom with hose
					Cemented to surface
					and placed protective
					cover over well.
Logging Geologist					
Kenneth Beach					

DRILLING RECORD

Date 2/15/85

Boring Number MW-

Driller

Bob Wolf

Water Table Information

SAMPLING RECORD				LOG	
Sample Recovery	Sample Number	Sample Depth	Blow Count	Depth	Description
					Soil description same as Soil Boring B-10
				27'	Hit rock
					very fractured to
					35'.
				50'	To bottom of boring
					installed five foot
					screen on 2" PVC
					well casing. Added
					gravel to 43'. Added
					1' of bentonite pellets
					to 42'. Formed a
					bentonite-Portland
					cement slurry and
					brought up to 4', by
					forcing to bottom w/hose.
					Cemented to surface
					and placed protective
					cover over well.
Logging Geologist Kenneth Beach					

DRILLING RECORDDate 2/18-21/85Boring Number MW-1Driller
Bob Wolf

Water Table Information

SAMPLING RECORD				LOG	
Sample Recovery	Sample Number	Sample Depth	Blow Count	Depth	Description
				80'	Soil description same as MW-Hit rock
					very fractured to
					90'.
				200'	to bottom of
					boring. Placed a
					5' screen on the
					end of 2" PVC well
					casing. Installed.
					Filled w/gravel
					to 190'. Bentinite pellets
					to 189'. Forced bentinite
					grout to bottom with small
					dia. piping and
					mixed cement with
					bentinite after a
					5' seal. Brought
					slurry up to 4'.
					Cemented to surface
					and placed on
					protective cover.
Logging Geologist Kenneth Beach					

Sundstrand Monitoring Well Water Levels

Well	Date						
	<u>2/27/85</u>	<u>3/13/85</u>	<u>3/22/85</u>	<u>3/26/85</u>	<u>4/5/85</u>	<u>4/11/85</u>	<u>4/23/85</u>
MW-1	804.40	806.07	806.54	806.59	807.20	807.22	807.66
MW-2	810.43	811.33	812.44	812.37	812.82	812.37	813.04
MW-3	---	---	---	---	---	---	---
MW-4	838.17	837.17	---	---	---	---	---
MW-5	806.45	808.15	809.03	808.86	809.51	809.26	809.91
MW-6	814.03	816.80	815.32	817.27	818.28	817.94	818.82
MW-7	807.22	807.89	808.29	808.33	808.66	808.80	808.89
MW-8	812.52	811.43	810.72	810.66	811.57	811.32	810.35
MW-9	797.17	798.42	798.62	798.59	799.12	799.09	799.32
MW-10	803.77	805.47	805.89	806.01	806.60	806.63	806.97
MW-11	809.34	808.34	808.51	808.48	809.36	809.63	816.15
MW-12	823.56	822.69	822.47	822.39	823.31	822.80	823.78
MW-13	814.06	816.56	817.40	817.47	818.65	818.28	819.23
MW-14	813.59	816.28	817.00	817.06	818.26	817.98	818.95
MW-15	806.26	807.98	808.69	808.69	809.31	809.02	809.69
MW-16	803.71	805.49	805.83	805.84	806.59	806.63	806.89

ATTACHMENT NO. 4

LABORATORY QUALITY CONTROL

LABORATORY EQUIPMENT

A substantial investment in laboratory equipment is necessary to properly perform high quality analytical work. AQUALAB is committed to a continuous expansion and upgrading of equipment and capabilities as required to maintain its total service commitment to clients. AQUALAB's present laboratory equipment includes:

H-P 5993b Gas Chromatograph/Mass Spectrometer
PE 703 Atomic Absorption Spectrophotometer
H-P 5840 Gas Chromatograph with ECD & TCD
PE 560 Atomic Absorption Spectrophotometer
Dohrmann DX-20 TOX Analyzer
H-P 5830 Gas Chromatograph with ECD & FID
IL 457 Atomic Absorption Spectrophotometer
H-P 5880 Gas Chromatograph with dual ECD, FID, & NPD
H-P 5880 Gas Chromatograph with ECD & FID
Jarrell Ash 530 Atomic Absorption Spectrophotometer
H-P 5890 Gas Chromatograph with FID
Packard Gas Chromatograph with ECD & FID
Waters 440/441 HPLC with 420 C&E Fluorescence
Dohrmann DC-80 Low Level TDC Analyzer
Sequoia-Turner Model 450 Fluorometer
Coulometrics liquid/solid TOC Analyzer
Nikon Photographing Microscope
Parr Oxygen Bomb Calorimeter System
Hitachi UV-VIS Spectrophotometers
Pye Unicam UV-VIS Spectrophotometer
Perkin Elmer Spectrophotometer

LABORATORY PROCEDURES

AQUALAB analyzes a wide range of sample matrices for a long list of parameters. The types of samples would include: water, foods, cosmetics, sludges, bottom sediments, grains, alloys, tissues, feed additives, hazardous waste, plastics, soils, fertilizers, and many more.

As is the case with all submitted analytical work, AQUALAB utilizes the current approved procedure or the most appropriate methodology. For example, any samples submitted in conjunction with requirements to satisfy U.S. Environmental Protection Agency permits or applications would necessitate use of USEPA methods. Many food products submitted for quality control would use procedures from the Association of Official Analytical Chemists.

Analytical protocols can be specified by the client or the appropriate method will be selected by the laboratory.

The following is a list of the principal agencies and associations that provide analytical method reference sources for laboratories like AQUALAB.

- U. S. Environmental Protection Agency
- Association of Official Analytical Chemists
- American Society of Testing Materials
- Institute of Food Technology
- AWWA/WPCF Standard Methods Committee
- Department of Public Health
- U. S. Department of Agriculture

A complete list of reference manuals, books, methods, etc. is available for review in AQUALAB's copyrighted Quality Assurance Manual.

In addition to all of the available reference methods, AQUALAB has written a complete Procedure Manual. This Manual not only gives the complete analytical protocol, but compiles the background information from all of the references and makes it part of the procedure. This would include such information as interferences, pretreatment, holding times, etc.

These detailed procedures in the AQUALAB manual were then summarized onto Procedure Cards. These 5-1/2" X 8-1/2" cards are sealed in plastic to be used by each analyst at the bench. Each person in the lab is trained to utilize these procedure cards rather than rely on memory which can cause long running data errors.

SAMPLE MANAGEMENT

The following is a table from 40 CFR 136, 12/3/79, to be utilized as a guideline for sample containers, preservation of samples, and holding times. This table is extremely important in assuring data reliability. AQUALAB provides all required sample containers, at no extra charge, to control contamination and preservation.

Parameter	Container	Preservative	Maximum Holding Time
Acidity/Alkalinity	P,G	None	14 days
Ammonia	P,G	H ₂ SO ₄ to pH<2	28 days
BOD	P,G	None	2 days
Chloride	P,G	None	28 days
Chlorine	P,G	None	on site
Chromium, hex	P,G	None	2 days
COD	P,G	H ₂ SO ₄ to pH<2	28 days
Color	P,G	None	2 days
Conductivity	P,G	None	28 days
Cyanide	P,G	NaOH to pH>12	14 days
Fluoride	P,G	None	28 days
Hardness	P,G	None	6 months
MBAS	P,G	None	2 days
Mercury	P,G	HNO ₃ to pH<2	28 days
Metals	P,G	HNO ₃ to pH<2	6 months
Nitrate	P,G	None	2 days
Nitrite	P,G	None	2 days
Nitrogen, total	P,G	H ₂ SO ₄ to pH<2	28 days
Oil & grease	G	H ₂ SO ₄ to pH<2	28 days
Organic compounds	G	None	7 days
pH	P,G	None	on site
Phenol	G	H ₃ PO ₄ to pH<2	28 days
Phosphorus	P,G	H ₂ SO ₄ to pH<2	28 days
Radiologicals	P,G	HNO ₃ to pH<2	6 months
Silica	P	None	28 days
Solids, all	P,G	None	7 days
Sulfate	P,G	None	28 days
Sulfide	P,G	Zinc acetate	28 days
Sulfite	P,G	None	2 days
TOC	P,G	H ₂ SO ₄ to pH<2	28 days
TOX	G	None	14 days
Turbidity	P,G	None	2 days

P = Plastic

G = Glass

With the exception of fluoride, metals, and radiologicals, all samples must also be kept at 4C in addition to the preservatives mentioned.

GENERAL DISCUSSION

The purpose of the independent analytical laboratory is to provide information that is accurate, reliable, and adequate for its intended use with absolute impartiality. To meet this purpose, AQUALAB has developed a complete Quality Assurance Program to guide the total operations of our laboratories from shipping of bottles to filing of reports. This program is described in full in our Quality Assurance Manual. This manual is the basis for instruction and direction in the establishment and maintenance of AQUALAB'S Quality Assurance Program. It describes the criteria, guidelines and recommendations for the physical resources, the human resources, the data validation and the mode of operation of the laboratory. Management, statistical, preventative, corrective, administrative, and investigative techniques are employed to maximize this achievement.

AQUALAB's copyrighted Quality Assurance Manual is representative of our great investment in total quality assurance. Therefore, we consider much of its content proprietary. While a manual is available for inspection and review at each of AQUALAB's offices, copies will only be allowed to leave the office when the party makes a request in writing and agrees to sign our release form.

The following table of contents from our Quality Assurance Manual gives a listing of all sections that are covered. As can be seen, AQUALAB has invested in an extensive program which covers every aspect of laboratory operations.

1. INTRODUCTION
2. QUALITY ASSURANCE OVERVIEW
3. ORGANIZATION FOR QUALITY
4. COSTS AND BENEFITS
5. TRAINING AND CERTIFICATION
6. PROCEDURE MANUALS
7. FACILITIES
8. PROCUREMENT CONTROL, REAGENTS AND REFERENCE STANDARDS
9. MAINTENANCE AND CALIBRATION
10. PACKING AND SHIPPING
11. DOCUMENT CONTROL
12. DATA HANDLING, REPORTING AND RECORDKEEPING
13. CUSTOMER RELATIONS
14. CALIBRATION CURVES
15. PRECISION, ACCURACY, AND PERCENT RECOVERY
16. INTERLABORATORY TESTING
17. DATA VALIDATION AND REVIEW
18. CLOSED LOOP CORRECTIVE ACTION AND FEEDBACK
19. AUDITS
20. REFERENCES

Q. A. MANUAL SUMMARY

In order to obtain a clearer picture of AQUALAB's commitment to quality, the following summary of each section is provided. For a more detailed review of our program, we invite you to meet with one of our Division Managers at your nearest Aqualab office.

SECTION 2. QUALITY ASSURANCE OVERVIEW

This section was written to provide a general overview of our Quality Assurance Program. This summary allows the reader to obtain a total picture of our program without reading the entire Q. A. Manual.

SECTION 3. ORGANIZATION FOR QUALITY

The establishment of a quality assurance program, as described in our Quality Assurance Manual, requires the assistance of all the people within AQUALAB to carry out the monitoring, recordkeeping, statistical techniques and other functions required by our system. This total commitment of all personnel to the production of reliable data is dependent upon the conscientious effort of everyone involved. Therefore it is important that each member of the organization have a clear understanding of his or her duties, responsibilities and their relationship to the company-wide effort. This section assists in that understanding by giving a structure and organization to this commitment to quality. Organization charts for the corporation and the divisions along with job descriptions for all personnel are provided.

SECTION 4. COSTS AND BENEFITS

Quality assurance costs are segregated and recorded to identify elements of our quality assurance program whose costs may be disproportionate to the benefits derived. This assists in carrying out policies in the most efficient and economical manner commensurate with continued accuracy and precision of the data produced. Simply stated - what are the real costs associated with our QA program in relationship to the benefits.

SECTION 5. TRAINING

The most important element in providing quality data is our people. Therefore it is vital to make sure every employee is thoroughly knowledgeable in their area of responsibility and can demonstrate competence on a regular basis in documented form. To attain this, we have a formal training program which not only insures that every employee knows what they're doing, but generates confidence that our analytical results are correct. This mandatory training program covers all aspects of our operation, including extensive training in quality assurance and safety.

SECTION 6. PROCEDURE MANUALS

A quality assurance program should assure that all work, from the ordering of materials to the reporting of results, be prescribed in clear and complete written instructions of a type appropriate to the circumstances. Manuals are not only written for our analytical testing programs but also for such aspects of our operation as maintenance, calibration, reporting, quoting, and invoicing. Procedure cards, when appropriate, have been developed for immediate reference.

SECTION 7. FACILITIES

Because of the extent to which the laboratory environment can effect the results of the analysis, the laboratory facility must be carefully planned and that plan periodically evaluated. In general, the physical conditions shall comply with applicable local building codes, OSHA requirements, EPA requirements, and/or other legal requirements. Emphasis will be placed on professionalism, efficiency, and safety.

SECTION 8. PROCUREMENT CONTROL, REAGENTS, AND REFERENCE STANDARDS

The quality of our reagents and chemicals can directly effect the quality of our analytical results. Described in this section are the procedures for ordering, receiving, marking, and storing materials, reagents, and chemicals. Minimum standards are specified to insure that these supplies do not jeopardize the quality of our analytical results.

SECTION 9. MAINTENANCE AND CALIBRATION

Because we rely so heavily on our instruments, it is the purpose of this section to assure that only properly maintained and calibrated instruments and equipment are used in the measurement process. Preventive maintenance is an orderly program of positive actions (equipment cleaning, lubricating, adjusting, reconditioning, and/or testing) to prevent instruments from failing during use. Calibration is the process by which a standard or piece of equipment of a given accuracy is compared against a standard or piece of equipment of a higher accuracy. Adjustments are made as necessary to assure that the standards or equipment are within the prescribed accuracy.

SECTION 10. PACKING AND SHIPPING

Because of the fragile and sometimes sensitive nature of samples and their containers, special precautions must be taken for handling, storage, packing and shipping to protect the integrity of the samples and to minimize damage, loss, deterioration, degradation, and/or modification. This section addresses acceptable sample containers, sample volumes, preservatives, holding times, chain of custody procedures, DOT shipping regulations, and the disposal of samples.

SECTION 11. DOCUMENT CONTROL

Sound procedural documentation of laboratory operations - from dishwashing and balance calibration to maintenance and analytical testing - are essential to overall quality control. Inaccurate or outdated procedures within a facility can cause severe quality problems. It is the purpose of this section therefore, to describe the system we use to ensure that current specifications, methods, and standards are in the hands of users and that they do not use obsolete documents. A system of distribution, review, approval, recall, and update is established and rigidly utilized.

SECTION 12. DATA HANDLING, REPORTING AND RECORDKEEPING

Essential to our business and clients is a systematic approach to our handling of the large amount of data we generate. This system should allow for rapid information recovery and access. It should also allow for the maintenance and the storage of this data for future

reference. It is the purpose of this section therefore to describe the system and the forms that are used to request, record, transcribe, report, and store the results of our analytical testing.

SECTION 13. CUSTOMER RELATIONS

Vital to our business is the establishment of a good working relationship with our clients. To assist in maintaining that relationship on a professional level, guidelines are established concerning turn-around time, emergency requests, customer complaints, and our rerun policy.

SECTION 14. CALIBRATION CURVES

Calibration curves are plots of the instrument response versus the concentration. 90% of the analyses we perform are based on a calibration curve and the validity of our data is dependent to a great degree on how well these are established. Since it would be impractical to develop a new standard curve every time an analysis is performed, we have established a method for verifying it with each set of samples. It is the purpose of this section to describe how calibration curves are developed and to establish the methods for their verification on a daily basis.

SECTION 15. PRECISION, ACCURACY, AND PERCENT RECOVERY

Our precision, accuracy, and percent recovery program is a continuing, systematic, in-house regimen intended to ensure the production of analytical data of continuing high validity. This is accomplished primarily by running precision, accuracy, and percent recovery control checks with every sample set. Control charts have been developed at the 99% confidence limit to plot this data as it is generated.

SECTION 16. INTERLABORATORY TESTING

The interlaboratory control program involves analysis of check samples (EPA, USGS, ERA, etc.) by each division laboratory in order to assess the continuing capability and relative performance of each. This program shall not be limited to check samples from the corporate office. Check samples from clients, EPA surveys, USGS surveys, certification programs, etc. are also analyzed.

SECTION 17. DATA VALIDATION AND REVIEW

This section describes the process whereby data are screened, and accepted or rejected based on a set of criteria. This involves a critical review of a body of data in order to locate dubious values. It may involve only a cursory scan to detect extreme values or a detailed evaluation requiring the use of a computer. Included in this section are anion-cation balances, chemical relationships, etc.

SECTION 18. CLOSED LOOP CORRECTIVE ACTION AND FEEDBACK

Experience has shown that most problems will not disappear until positive action has been taken by management. The significant characteristic of any good management system is the step that closes the loop - the determination to make a change if the system demands it. This section establishes a mode for correcting a deviation, fixing responsibility for the action required, documenting the steps taken, and securing a report on the resolution of the problem.

SECTION 19. SYSTEM AUDITS

Our QA Program dictates a number of steps, procedures, and documentations that must be followed in order to ensure the accuracy and reliability of our results. All that is needed then, is a follow-up system to ensure that all items dictated in this manual are being carried out. This section describes the three different auditing systems that we use. 1.) Divisional - each division manager is required to do an internal audit at least every quarter. 2.) Corporate - auditing is performed by the Vice-President of Laboratory Operations at least annually. 3.) Other - These audits are performed by our clients or regulatory agencies as needed to satisfy their own QA programs or as a prerequisite to obtaining a specific job or certification.

**LABORATORY TEST RESULTS
GROUNDWATER SAMPLES
SUNDSTRAND AVIATION OPERATION
ROCKFORD, ILLINOIS**



JCR Consultants, Inc.
Geotechnical Engineering,
Hydrogeology and Water Quality

- PRIVILEGED AND CONFIDENTIAL -

November 18, 1985

Mr. William Coole
SUNDSTRAND AVIATION
Department 910-6
4747 Harrison Avenue
Rockford, Illinois 61125-7002
Subject: Project Number 85035

Dear Mr. Coole:

At the request of Mr. Curtis Rosser of Sundstrand Aviation Operations, Denver, Colorado, JCR Consultants, Inc. obtained groundwater samples from three monitoring wells at the Sundstrand Aviation Rockford, Illinois plant on September 5, 1985. The monitoring wells sampled were MW-13, MW-10 and MW-17. (See Table 1.0 for well details.) These wells represent one upgradient well (MW-13) and two downgradient wells (MW-10 and MW-17). MW-13 is upgradient of the entire plant site, while MW-10 is downgradient from the main plant facilities and MW-17 is downgradient from the experimental facilities. (See Figure 1.0 for monitoring well locations.)

Prior to sampling, water level measurements were obtained in each well (see Table 1.0). The monitoring wells were sampled using a positive displacement pump (PDP). The PDP consists of a 6 foot long, 1-3/4 inch diameter stainless steel pump which samples groundwater by displacing water in the pump with nitrogen within specific time intervals. Approximately two casing volumes were evacuated from each well prior to sampling. The groundwater samples were placed in sample jars with appropriate preservatives. The sample jars were placed in ice in a plastic carton and shipped to the Western Research Institute laboratory in Laramie, Wyoming on the same day the samples were obtained. The Western Research Institute (WRI) laboratory was chosen to do the routine analysis because of its ability to conduct U.S. Environmental Protection Agency recommended analyses (WRI is a contract laboratory to U.S. EPA), and its reputation for providing accurate and defendable results. A copy of Western Research Institute's Quality Control and Quality Assurance Manual is contained in Appendix A.

JCR Consultants, Inc. was requested to perform volatile (VOA) and semi-volatile (BNA) analyses of these samples. The analytical procedures utilized to conduct these analyses were those specified by the U.S. Environmental Protection Agency IFB Protocol WA-85-J266. In addition, JCR Consultants, Inc. was also requested to analyze the water samples from MW-17 for the presence of Otto Fuel II. The specific chemical formulation for this compound includes:

Propylene Glycol Dinitrate (PGDN)
2 - Nitrodiphenylamine (2NDPA)
Di-n-butyl Sebecate (DBS)

The method of analysis for this compound was high resolution mass spectrometry for each of the fuel compound constituents listed above.

Table 2.0 is a summary of the laboratory test results for VOA and BNA analyses for the groundwater samples. Attachment B contains all of the laboratory test results.

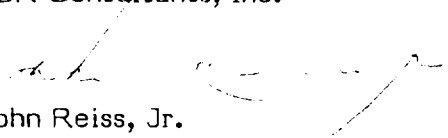
The method blank and field blank are used for quality control purposes. Methylene chloride, acetone, toluene and bis(2-ethylhexyl) phthalate detected in both the method and field blanks are common laboratory contaminants. The presence of 1,1,1 - trichloroethane in the field blank can be attributed to analytical error or minor cross contamination from sample MW-10 where a high concentration of this contaminant was detected. The presence of phenol in the field blank is most likely due to laboratory contamination or analytical error. With the exception of benzo(a)pyrene that was detected in samples obtained from wells MW-13 and MW-17, and benzoic acid found in the sample from MW-17, the samples indicate relatively clean groundwater. The groundwater sample obtained from well MW-10 did contain detectable concentrations of several organic hazardous substances the highest being associated with 1,1,1 - trichloroethane (680 ug/l).

All three fuel compounds associated with Otto Fuel II are considered to be present in the groundwater sample in well MW-17, based on the results of the high resolution mass spectrometry. Ion abundances for each compound were observed for all three compounds, with the intensity for DBS being significantly stronger than the intensities for PGDN and 2NDPA.

If you have any questions or if I can be of further assistance, please call me at (303) 745-2200.

Sincerely,

JCR Consultants, Inc.



John Reiss, Jr.
Vice President

JR/lw

enclosures

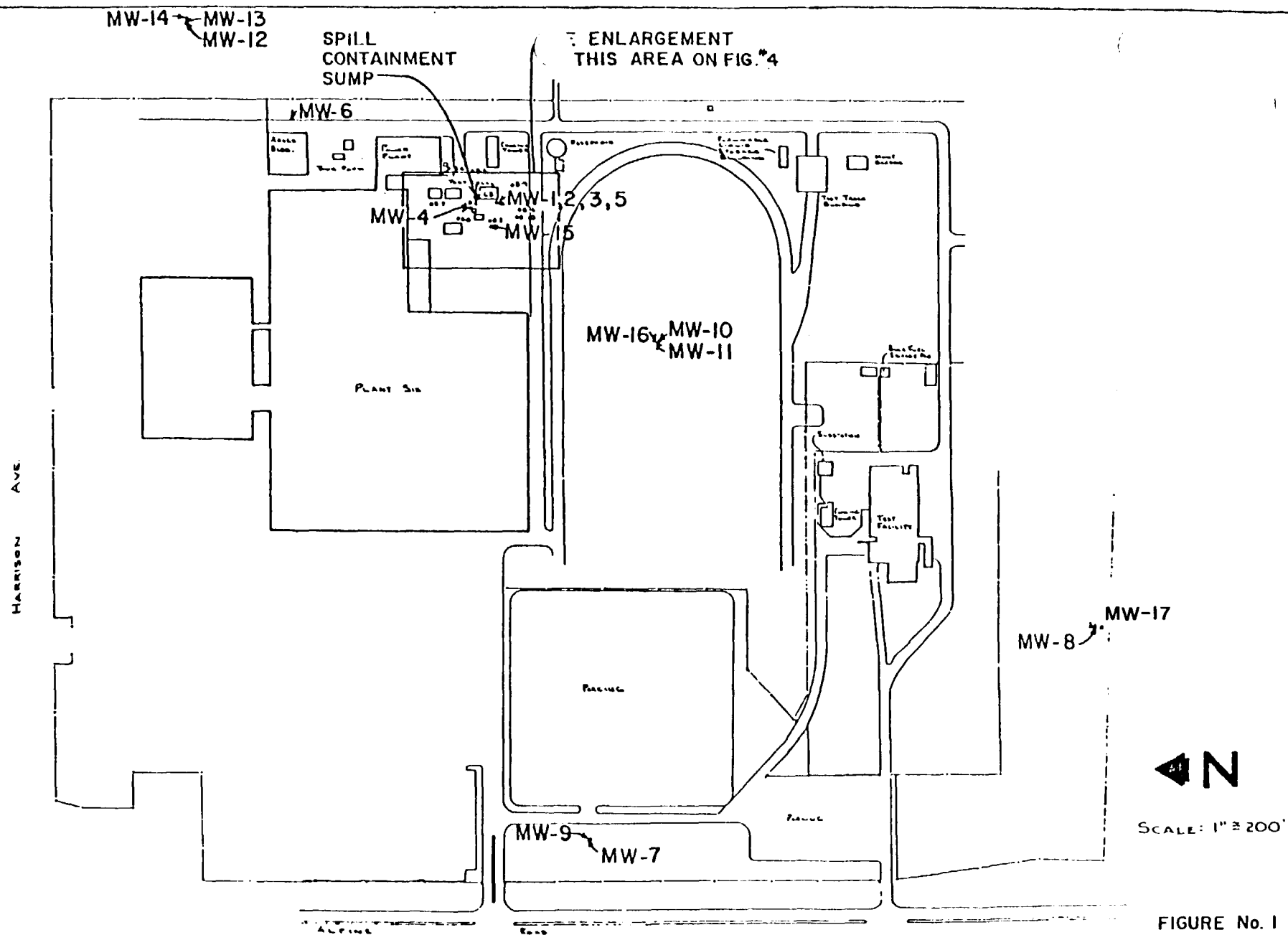


FIGURE No. 1

TABLE 1.0

MONITOR WELL INFORMATION

<u>Well #</u>	<u>Description</u>	<u>Depth In Feet</u>	<u>Water Level (Ft below Ground Surface 9/5/85)</u>
13	Upgradient of Plant	65.6	34.08
10	Downgradient of Main Plant Facility	87.4	40.95
17	Downgradient of Experimental Facilities	200.0	12.38

TABLE 2.0

SUMMARY OF LABORATORY TESTING PROGRAM

<u>Sample</u>	<u>Compound Detected</u>	<u>Concentration (ug/l)</u>
Method Blank	Methylene Chloride	2.8
	Acetone	9.5
	Toluene	0.78
	Bis (2-ethylhexyl) Phthalate	10.0
Field Blank	Acetone	20.0
	1,1,1 - Trichloroethane	1.3
	Toluene	0.57
	Phenol	9.4
MW-10	Acetone	16.0
	Carbon Disulfide	133.0
	1,1 - Dichloroethane	5.0
	Trans - 1,2 - Dichloroethane	3.5
	1,1,1 - Trichloroethane	680.0
	Trichloroethane	60.0
	1,1,2 - Trichloroethane	2.0
	Tetrachloroethane	43.0
	Toluene	0.5
	Bis (2-ethylhexyl) Phthalate	9.6
	Benzo(a)pyrene	4.3
MW-13	Methylene Chloride	1.0
	Acetone	26.0
	Toluene	0.49
	Bis (2-ethylhexyl) Phthalate	28.0
	Benzo(a)pyrene	10.0
MW-17	Acetone	21.0
	Toluene	0.5
	Benzoic Acid	3.8
	Bis (2-ethylhexyl) Phthalate	9.9
	Benzo(a)pyrene	4.2

ATTACHMENT A
WESTERN RESEARCH INSTITUTE
QUALITY CONTROL AND QUALITY ASSURANCE MANUAL
FOR ANALYTICAL MEASUREMENTS

QUALITY CONTROL AND QUALITY ASSURANCE
FOR ANALYTICAL MEASUREMENTS

WESTERN RESEARCH INSTITUTE

Linda J. McGowan

John F. Schabron

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TABLE OF CONTENTS

1. WRI Policy Statement on Quality Output
2. Objectives and Importance of Quality Control and Quality Assurance
 - 2.1 Project Planning
 - 2.2 Direction of Research
 - 2.3 Data Validation
 - 2.4 Professional Responsibility
 - 2.5 Check on Method Applicability
3. WRI Quality Control Program
 - 3.1 Introduction
 - 3.2 Application of QC Procedures to Published Methods
 - 3.2.1 Scope and Applicability of Method
 - 3.2.2 Calibration
 - 3.2.3 Replicates
 - 3.2.4 Spiking
 - 3.2.5 Blanks
 - 3.2.6 Reporting Results
 - 3.2.7 Data Reduction and Documentation
 - 3.2.8 Instrument Maintenance Logbooks
 - 3.3 Development of New Methods
 - 3.3.1 Method of Challenging Experiments
 - 3.3.2 Documentation of Methods
 - 3.3.3 WRI Method File

- 3.4 Statistics
- 3.5 Quality Control Charts
 - 3.5.1 Types of Charts
 - 3.5.2 Accuracy Charts
 - 3.5.3 Precision Charts
 - 3.5.4 Calibration Charts
- 3.6 Sampling Considerations
 - 3.6.1 Sampling Procedures
 - 3.6.2 Sample Custody
 - 3.6.3 Sample Tracking System
 - 3.6.4 Sample Preservation and Preparation
- 3.7 Glassware, Reagents, and Laboratory Practices
- 4. WRI Quality Assurance Program
 - 4.1 Introduction
 - 4.2 The Quality Assurance Officer (QAO)
 - 4.3 Performance and System Audits
 - 4.4 Quality Assurance Reports to Management
 - 4.5 Corrective Action
- 5. References
- 6. Definitions

1. WRI Policy Statement on Quality Output

Western Research Institute is strongly committed to quality assurance and quality control standards at all levels of research. High priority and a considerable amount of attention are given to developing and maintaining effective quality assurance and quality control procedures. It is WRI's policy and practice to include QA/QC programs with in-house and outside contractual research proposals.

The use of designed research experiments supported by strong quality control measures by WRI consistently results in high quality work products. WRI's reputation as a leader in fossil fuel research is based on the superior quality of work produced by WRI and predecessor organizations. As WRI moves into new research areas, the same high standards of quality assurance and control will be established in these new areas, ensuring that WRI retains its reputation of superiority.

2. Objectives and Importance of Quality Control and Assurance

The objectives of a quality assurance and control program are to monitor and control analytical measurements to ensure that the limitations of the resulting analytical data are known. Data are continuously monitored by control charts to determine the degree of precision and accuracy. This approach immediately detects outlying data points or other problems in analytical procedures. Assessment on the degree of control of a procedure is then made. When greater confidence is required, the analytical procedure is evaluated in order to make changes to obtain the desired region of statistical control.

2.1 Project Planning. The importance of including a QA/QC program in a total project plan is recognized. The incorporation of QA/QC procedures planning into project criteria specifies steps that are fundamental to the project's objective. Preliminary planning can aid in:

- o Foreseeing potential analytical problems,
- o Helping define the objective or intended use of the data,
- o Producing greater efficiency in attaining the desired results.

Criteria that are considered when planning a technically and statistically sound study include:

1) Confidence Level Required

The level of confidence for analytical results is based on the objectives of the study. This decision is directly related to the costs of obtaining data. In order to be cost effective, this requires that the appropriate level be selected. Obtaining high confidence level data usually costs more than data having lower confidence levels. Standard analytical methods, or those well characterized and normally used in a laboratory provide higher confidence levels than experimental analytical procedures. New procedures require the development of confidence levels and as a result generally cost more.

2) Limits of Quantitation Required

The requirement for a particular limit of quantitation is determined by the study objectives. The level of measurement required may influence the method used. Utilizing instrumentation with greater sensitivities generally is associated with higher analytical costs. Costs may also be influenced by sample preparation and required sample size, which are dependent on the analytical method and accuracy required.

3) Degree of Confidence and Quality Assurance Needed

The degree of confidence in data is directly related to the quality assurance program. More rigorous quality assurance programs are required to obtain higher degrees of confidence in the precision and accuracy of data. More rigorous quality assurance programs also are associated with higher analytical costs.

4) Method Validation

Method validation is required to determine that the required levels of confidence and limits of quantitation are being obtained with the analytical method. If a method cannot meet the designated levels, the method is re-evaluated or the levels of confidence or experimental goals are modified. WRI's QA/QC program includes both intralaboratory and inter-laboratory validation.

2.2 Direction of Research. The direction of a research project is dictated by client's research objectives. In order to ensure a study's continuity and objectivity, the investigation should relate all data interpretation to the research objectives throughout the duration of the study. Data that may significantly alter the course of a project are thoroughly discussed with the sponsoring client prior to continuing the study. Quality control measures are

essential to every phase of a study to ensure accurate data interpretation and project direction.

2.3 Data Validation. WRI's quality assurance and control programs ensure that analytical data can undergo the most stringent legal scrutiny, if necessary. Validation is particularly important in regulatory compliance and patent rights.

The validation process involves internal or external laboratory corroboration for methods used. Standard reference materials are used to evaluate the suitability of methodology. Analytical results obtained in a screening program or for process adjustment do not always require method validation. The end use of the analytical data dictate the degree of method validation required. For example, a validated analytical method is required for regulatory compliance studies.

The documentation procedures outlined in Section 3.2.7 are followed for data validation.

2.4 Professional Responsibility. The level of training and qualifications of personnel performing chemical analyses is of primary importance to a good quality control program. WRI's professionals are well qualified and are personally committed to QC procedures.

Training is required for new personnel and whenever a new procedure is used in WRI's laboratories.

The researcher's responsibility includes frequent communication on the research project goals, progress, and the QC procedures to the client and all other personnel involved in the project. The analyst has the responsibility to carry out the established QC program routinely.

2.5 Check on Method Applicability. One of the most important points in a QC program is that it provides a means for the analyst to determine how well a method is working. This is especially important in the analysis of environmental samples because many published methods (EPA, ASTM) may not be directly applicable due to the high degree of variability in the matrices. Steps for method applicability assessment are outlined in Section 3.2.

3. WRI QUALITY CONTROL PROGRAM

3.1 Introduction. WRI's senior management has committed the resources necessary to ensure that WRI's Quality Control program can meet the requirements of our clients. WRI's quality data is produced by experienced researchers and technicians who are committed to their work. To maintain high quality data output, all methods and procedures used have associated with them steps to ensure against generation of inappropriate data. WRI's policy is that the quality of the data must always meet the study's objectives. Analytical methods and sample handling procedures are used within their defined limitations unless documentation and justification of variations are made.

Specific quality control procedures used in a particular study vary depending whether the analytical method is a proven, published method such as an ASTM or EPA method, or an unproven or modified method used to address study-specific issues. QC procedures for EPA water analysis methods are not necessarily the same as those for ASTM fossil fuel physical tests or elemental analyses. Each methodology has specific and unique QC checks. It is WRI's policy that no QC short-cuts be taken, and where there is doubt, as many QC checks as are needed to ensure that the data can be used to meet the study's objectives are applied.

In addition to the following guidelines, specific QC considerations described in References 1-8 are consulted and followed when applicable.

3.2 Application of QC Procedures to Published Methods

3.2.1 Scope and Applicability of Method. Before a published method, such as an EPA or ASTM method, is applied to a particular sample type, the scope and applicability of the method to the sample type is confirmed. The limits of detection and limits of quantitation for the method are checked. If the sample type is different from that for which the method was designed, spiking experiments and repeatability studies are performed and documented before analytical data are acceptable. Major method alterations are fully justified and documented. Significantly altered methods are written in WRI format and placed in the WRI method file for future reference and use.

3.2.2 Calibration. Full set calibration is run daily or with each sample set for methods requiring calibration curves or instrument calibration. The calibration brackets analyte levels. Midpoint calibration checks are made with every tenth sample or as needed. Proper instrument operation is checked with known standards daily or for techniques in which a calibration is not performed. ASTM fossil fuel physical methods are checked by analysis of known standard samples.

3.2.3 Replicates. Sufficient replicate determinations are made to achieve the confidence required to meet the study objectives. Small batches of samples of various sample types or sources are analyzed

in duplicate. One duplicate analysis for every ten samples is run for large sample batches of similar type. Should the duplicate runs have a wider spread than expected, additional replicates are run. Precision QC charts are used as described in Section 3.5.

3.2.4 Spiking. Spiking is performed extensively to ensure adequate recovery of analyte. For small batches of samples of various sample types or sources, samples are spiked at an expected midpoint analyte concentration. Spiking is performed on the as-received sample prior to sample preparation such as extraction or distillation, to adequately ensure method performance for the samples. One sample spike for every ten samples is run for large sample batches of similar type. Accuracy QC charts are used as described in Section 3.5 to monitor for variation in the method or technique. When QC guidelines are not available, a guideline of 90-110% recovery is used. Careful examination of results is required when the spike recoveries fall outside this range.

3.2.5 Blanks. Blanks are run for the particular sample analysis method used, when applicable. Blank analysis does not apply to ASTM physical test methods such as pour point and viscosity. Blanks prepared in the field such as for environmental samples are run when available. All potential outside sources of erroneous results are considered when results are reported. Blanks are run daily and with each batch of samples analyzed. Blanks are also run with any change in source of solvents, water, batch of reagent, or source of glassware.

3.2.6 Reporting Results. When reporting results based on analysis of a sample with a particular method, the limitations of the method must be considered. A "less than" value corresponding to the method's quantitation limit is used when no analyte is detected. It is not acceptable to enter "ND" or "0%" as the results. The number of significant figures used when reporting results is always considered. Data reported to more than three significant figures are generally not appropriate, depending on the method used and the analyte level. WRI's guideline is that the smallest digit in a result that varies in replicate runs, is the last digit reported.

3.2.7 Data Reduction and Documentation. WRI policy on technical records requires that all data are recorded directly into bound WRI laboratory notebooks in ink when the data are generated. This procedure minimizes errors that may occur when data transfer is not made immediately and provides a defensible legal document if required. In some instances, approved data sheets unique to certain analyses are used if they are filled out in ink and pasted into the notebook when complete. All entries are signed and witnessed daily. Any corrections or changes in entries are made in ink so as not to render the prior entry illegible. Corrections are signed and witnessed at the time of the entry. WRI notebooks are assigned sequential numbers and are in the custody of the librarians for checkout and use. They are locked up at night, and cannot be removed from WRI without written permission from the Chief Executive Officer or Chief Scientific Officer. All samples studied at WRI

have a sample number consisting of the WRI notebook number followed by a comma, followed by the page number, followed by an optional alphanumeric identifier. This allows cross-referencing and tracking of any sample studied. Samples from outside WRI are logged into a WRI notebook and assigned a sample number by the individual coordinating the work with that sample.

Data reduction is documented in detail. Microprocessor or computer printouts, or approved data sheets are included in the notebooks prior to signing and witnessing of pages. Analytical reports in the notebooks consist of neatly arranged legible results with the appropriate amounts of significant figures. The report of analysis contains the analytical notebook number, page, the sample number, and sample description. Any chromatogram, ICP computer printout, or spectra recorded has written on it the analytical notebook number and page on which the conditions and calibrations used are described, as well as the sample identification number. Data stored on floppy or moving head discs are coded with a designation pertaining to the sample. Discs and notebooks are secured at night and when not in use. The notebooks contain disc numbers and coded names of spectra as well as the actual sample number or identification.

3.2.8 Instrument Maintenance Logbooks. Maintenance logbooks are kept for all WRI analytical and spectroscopic instrumentation. These are used to identify preventative maintenance timetables, document chronic instrument problems, and to facilitate repairs. A

maintenance logbook consists of a bound notebook labeled on the front cover with the name of the instrument and is kept with the instruments. Scheduled maintenance procedures, major adjustments, part changes, operating problems, or repairs are entered clearly and legibly into the notebook. Entries are chronological, and are signed and dated by the person making the entry.

3.3 Development of New Methods

3.3.1 Method Challenging Experiments. Analytical method development is constantly required to respond to challenging and evolving research areas and sample types. Techniques documented in the literature often are utilized in the design and structure of new methods. Existing and accepted methods often require significant modification. The development of new analytical methods requires a series of method challenging experiments, including spiking, sample size variation, repeatability, and real sample analysis runs. Spiking is performed in the development work at two levels and in duplicate for several real samples. Standard compounds are run through any proposed separation method scheme to document recovery levels and ensure that chemical reaction or sample alteration does not take place. If spiking experiments indicate problems with the proposed method, the method is altered accordingly and the spiking experiments repeated.

Sample size variation studies are performed to detect significant constant errors associated with the proposed method.

Sample size variations significantly above and below the range proposed for the routine application of the method are made. Sample size variation runs are made in duplicate for several real samples.

The method's precision is obtained by analyzing a few real samples at least seven times each for the analyte of interest and calculating the standard deviation, relative standard deviations, and confidence limits, as outlined in Section 3.4. Each replicate determination starts with an as-received sample which is subjected to the full sequence of sample preparation and analysis steps.

In addition to the above method challenging experiments, a series of real samples from different sources, if available, is analyzed by the proposed method in duplicate to get some idea as to how amenable different samples from possibly different sources are to the proposed methodology.

3.3.2 Documentation of Methods. Method development experiments are routinely and fully documented in accordance with WRI's laboratory notebook policy. All analytical methods developed or significantly modified at WRI are documented in a uniform WRI format for filing in WRI's centralized methods filing system. The uniform format is provided in Section 3.3.3. A WRI method number is attached to each method to allow for easy reference, cataloging, and filing in a central location. Methods not developed or significantly altered by WRI, such as EPA and ASTM methods, are not included in the centralized system because they are already in convenient form and are easily located.

Methods utilized by various analytical service groups, including WRI methods and established methods, such as ASTM or EPA, are assembled into methods manuals. A three-ring binder is convenient to use for this purpose. These manuals are available to all WRI analysts. Alterations or precautions which apply to the method are entered into the methods manuals. All methods manuals are updated whenever changes are made.

3.3.3 WRI Method File. An outline of the format to be used in documenting WRI methods is provided below:

WESTERN RESEARCH INSTITUTE
ANALYTICAL METHOD NO. _____

METHOD TITLE

I. APPLICABILITY

- A. Sample Types
- B. Lower and Upper Limits of Detection

II. SUMMARY

- A. Method Description
- B. Sample Amount Required and Preservation
- C. Instrumentation
- D. Time of Analysis
- E. Precautions

III. EQUIPMENT AND REAGENTS

- A. Glassware
- B. Chemicals
- C. Instrument Settings

IV. PROCEDURE

- A. Standard Preparation
- B. Sample Preparation
- C. Reagents

- D. Standardization
- E. Sample Analysis
- F. Quality Control Procedures

V. COMMENTS

- A. Accuracy Statement
- B. Precision Statement
- C. Discussion
- D. Precautions
- E. Reference to Development Data

3.4 Statistics

Replicate analytical results are generally not identical because of random fluctuations and limitations inherent in the methodology used. When a method is developed and verified with a specific sample type, the limitations of the analytical data are defined by spiking experiments and replicate runs. Expected accuracy and precision may vary with different sample types. For methods of widespread interest, repeatability between laboratories can be gauged with interlaboratory validation or round robin studies. Several statistical tools are typically used to evaluate numerical data. These tools generally include the mean, standard deviation, relative standard deviations, and confidence limits. These basic statistical tools make certain assumptions which must be considered in the experimental or method design. An awareness of statistical assumptions allows the data to be reduced to a usable form and ensures that the application or interpretation of the data are appropriate. To do this, the various statistical tools mentioned above are used. Definitions of the above statistical parameters are included in Section 6.

3.5 Quality Control Charts

3.5.1 Types of Charts. Quality control charts are used routinely at WRI. Two types of charts are available, one to monitor accuracy, and the other to monitor precision. The assembly and utilization of these charts is described in detail in Reference 1.

3.5.2 Accuracy Charts. Accuracy charts are generally a plot of the percent recovery of spikes vs. the number of samples analyzed, in chronological order. A limit of plus or minus three standard deviations limit is established for average recovery based on measured method performance for a particular sample type. Deviations outside this limit, or seven consecutive values on the same side of the mean indicates a situation that requires attention. Samples are re-run before data are reported.

3.5.3 Precision Charts. Precision charts are generally plots of some function of the difference between replicate runs vs. the mean result of the measurement. This relative difference between replicates often increases significantly because of background levels and noise as the analyte level drops. The industrial factor I is a common function of replicate run differences. It is the absolute value of the difference in duplicate results divided by the sum of the results. A precision QC chart is a plot of I vs. the average value. An upper limit cutoff curve is drawn on the chart. Any value of I which appears above the curve in future runs indicates further replicate runs are needed to identify potential outliers. The chart is updated continuously as data are generated.

The expected method performance may vary for different sample types and different sources. The QC precision charts give the analyst instant access to WRI past experience with the method under consideration and the expected performance of the method. Data resulting from a method for which the QC chart criteria are not met are not to be used without full disclosure of the data's limitations.

3.5.4 Calibration Checks. Methods utilizing calibration curves or calibration factors with standards are used routinely. For such methods, the typical slope, intercept, correlation coefficient, or calibration factor is documented in an accessible location such as a methods manual, WRI method document, or is included with the QC charts. This information is used to call to the attention of the analyst instrument, reagent, or method problems that might be missed otherwise.

3.6 Sampling Considerations

3.6.1 Sampling Procedures. The purpose of sampling is to obtain a representative portion of the population of interest. The sampling program chosen depends on the types of samples required, the analytical procedures to be used, and the objective of the study. WRI sampling persons record all activities and observations in a bound laboratory notebook. For water samples from flowing streams, flow measurement are performed if deemed necessary, according to

USDI, OWDC, ASTM, or EPA guidelines. The sampling protocol and logistics, including amounts and frequency, are tailored to the objective of the study. Statistical methods and scientific judgment are utilized and documented when sampling protocols are established.

Sample preservation techniques prescribed by EPA or ASTM are adhered to when applicable. Sample preservation techniques are dictated by the various analytical methods used to evaluate the sample. For new analytical methodologies, scientific judgment and experience are used in the selection of preliminary preservation methods. Preservation methods are evaluated as part of the method development work.

Duplicate samples are collected to check sampling precision. Some samples are split into two subunits for analysis as an analytical procedure QC check. Some samples also are spiked as an extended QC check of sample preparation, analytical, and sample preservation techniques. Sample preservative blanks are prepared and analyzed to check for preservative and container contamination.

All samples collected are identified with sample labels that include a WRI notebook and page number on which the sampling program is described. The information includes date and time of sampling, sample source, sampler's name, sample amount, analyses to be performed, preservatives used, potential hazards, and methods of handling samples if required. Other relevant information is also recorded.

The types of sample containers used are based on those recommended by EPA or ASTM procedures. If published guidelines are not available, scientific judgment and good laboratory practices apply. Container types are documented.

3.6.2 Sample Custody. Some projects or contracts require documented court-defensible chain-of-custody sample transfer. In such cases, the following procedures are adhered to:

Sample forms are filled out at the time field samples are collected and appropriate information is recorded in a bound WRI laboratory notebook. Samples are accompanied by a chain-of-custody record during transfer to the appropriate laboratory. When samples are passed from one person to another, both sign, date, and record the time.

Samples are packaged properly for shipment with a separate custody record attached to each shipment. Shipping containers are sealed or locked. The chain-of-custody sample form includes the method of shipment, shipper identification and other relevant items.

A record is kept whenever samples are split with another party and shows with whom the samples were split. Both the sampler and the sample-split recipient signs the form. The person delivering the samples to any party requests the signature of that party to document receipt of the samples. It is noted on the record if no one is available to sign on sample delivery.

All sample shipments are accompanied by a chain-of-custody record. The original sample form is sent with the sample and a copy is kept by a party involved in sampling. Sample containers sent by mail are registered with return receipt. All shipping records are kept with the sample form copies.

Chain-of-custody documents are maintained within the laboratory if the data may be used in court. The practices recommended by EPA to establish adequate chain-of-custody are followed.

One full-time employee is designated as the WRI sample clerk. Samples are handled only when necessary. Only the sample clerk receives samples delivered to the laboratory. Receipt of samples is documented by signing the appropriate forms and, if appropriate, the sample labels. The laboratory retains the sample forms with the sample records. A locked storage area is available for storing as-received samples or sample extracts.

3.6.3 Sample Tracking System. Samples analyzed by the various analytical support groups at WRI are included in a sample tracking system designed to document all sample movement within WRI. When a sample is submitted for analysis, a form describing the sample source, appropriate WRI notebook reference, precautions if any, and test requested, is submitted to the sample receiving area. All samples are labeled with labels obtained from the sample receiving area. "Danger" or "Keep in Refrigerator" labels are available and

are used as appropriate for toxic, carcinogenic, or labile samples. Information on the identification label includes the submitter's name, address, extension, the WRI notebook sample reference number, and account number. Upon receipt of the sample, the sample is assigned a sequential sample number. A label with that number is put on the sample container, and the number is entered onto the sample test request form by the sample custodian. The sample is then placed on a shelf in an appropriate sample storage area, such as a locked sample storage room or refrigerator if required. Whenever the sample is moved from its storage area, the analyst removing the sample signs out the sample from a logbook on the appropriate page bearing the sample number. When a sample is signed out, the date, analyst's initials, and the test are recorded in ink. The date of return is entered upon return of the sample to the storage area. The sample is logged out when all tests are completed. Since the customer generally is best equipped for proper sample disposal, it is returned to the customer unless otherwise requested. Additional sample tracking procedures, such as nightly lockup, are performed if required by the contract governing the study.

3.6.4 Sample Preservation and Preparation. Sample preservation guidelines published by EPA or ASTM are followed when available. Container types specified in the methods are used. Sample preservation methods and acceptable sample holding times are noted on the analytical service request form.

Obtaining representative solid samples and performing sample preparation require careful and thorough documentation. A solid sampling procedure is followed which will produce an unbiased sample that can be analyzed at the desired degree of precision for specific constituents. It is imperative when collecting representative solid samples for analysis that the sample's particle size distribution represents the true particle size distribution. When applicable, EPA and ASTM procedures are followed. For example, ASTM sampling methods for coal analyses take into account the fact that solid samples are generally heterogenous in nature and address the complexity which can be involved in obtaining a representative sample.

3.7 Glassware, Reagents, and Laboratory Practices

To generate quality data, careful consideration is given to the tools used to generate the data. Glassware is maintained in a clean state. A minimum procedure for preparing glassware includes washing with detergent, rinsing with tap water followed by distilled water. For many analyses, additional cleaning steps such as acid rinses are required. The analysts are aware of the cleaning procedures necessary for various tests. Glassware prepared especially for a certain type of test is stored in a separate area.

The purity of chemicals and solvents required is usually specified in the method. Generally, this is not a serious problem since most chemical supply houses sell reagents of adequate purity. Water,

however, is usually prepared in-house by various distillation or chemical removal cartridge steps. Periodic analysis of laboratory water for various parameters of interest is performed to document and insure its quality. Records are kept of maintenance of laboratory water purification systems to document items such as change of ion exchange cartridges and results of regular water quality analyses.

Good housekeeping is adhered to for generating quality output. Dust and dirt is not allowed to accumulate on lab benches or instrumentation. A weekly clean-up time is designated to maintain laboratories in clean condition. Equipment not used for more than six months is scrutinized for possible storage in a location other than in the laboratory.

4.0 WRI QUALITY ASSURANCE PROGRAM

4.1 Introduction

A quality assurance program provides assessment and documentation to ensure that the quality control procedures employed are working. The main mechanism of a quality assurance program is the analysis of known reference materials, standards, and blind duplicates. A good quality assurance effort provides useful feedback to the analyst and thus acts as a quality control device if problems are detected.

4.2 The Quality Assurance Officer (QAO)

The QAO is a professional staff member at WRI whose primary duty is to design schedules and programs for QA report generation. The QAO is not directly involved in the line of data or result generation at any level. One function of the QAO is to submit blind samples of known or standard EPA or NBS reference materials and blind duplicates on a regular schedule to various service groups for quality assessment. The tests which will undergo this scrutiny and the frequency of the QA checks are determined by the QAO in conjunction with upper management, project managers, and analysts. Such checks are run on a quarterly basis unless the method dictates otherwise. The results of the checks are used to write quarterly QA reports to management, and to interact with the analytical service groups to identify any apparent problem areas. The QAO also recommends solutions to QA/QC problem areas brought to light. The QAO assists project managers and analytical service

groups in planning QA/QC strategy and protocol towards the goal of generating the highest quality defensible data possible within the scope of the individual tasks and projects. In support of specific projects, short term QA/QC programs are designed by the project manager in conjunction with the QAO and the analysts involved. These programs include frequent checks of methods with blind standard or spiked materials and blind duplicates. All parties involved receive reports of results. Any problems detected are brought to the analyst's attention as soon as they are detected, so that corrective measures can be taken without delay.

4.3 Performance and System Audits

Performance audits are conducted by the Quality Assurance Officer using sample sets containing representative arrays of organic and inorganic compounds in matrices normally the subject of analyses under current studies at WRI. These sample sets are also be sent to one or more participating laboratories to evaluate the reproducibility of results.

To ensure that WRI laboratories are maintaining the necessary levels in instrumentation, levels of experience in personnel and QA/QC activities, annual system audits are performed. These are arranged by the Quality Assurance Officer in conjunction with the Chief Scientific Officer, who arranges for selection and scheduling of the various technical consultants to be utilized. The consultants are required to provide WRI with written reports on observations and opinions regarding

the items agreed upon prior to the audit. The reports are utilized to document or improve the WRI commitment to quality output.

4.4 Quality Assurance Reports to Management

The reporting of the various aspects of the Quality Assurance/Quality Control program is through both written and oral communication. Laboratory supervisors review laboratory operations and QC with analysts on a weekly basis. The supervisors inform management of the status of the program in their monthly reports. These monthly reports identify problems and provide the backing of management for actions required to correct problems. In addition, the WRI Quality Assurance Officer provides quarterly reports to management documenting the performance of the various laboratories in their analyses of samples and standard material submitted to them as part of the Quality Assurance program. The system audit reports generated annually by the various consultants employed are also utilized by management to maintain quality data output.

4.5 Corrective Action

The Quality Assurance Officer requests the laboratory supervisor to repeat analytical measurements and to check the records for reference material for results which showed significant error. If this investigation indicates that an error was made in analysis, transcribing results etc., the new value is recorded and a revision of the analytical report is issued. Problems which caused erroneous results are corrected with full documentation. Re-analyses are performed as deemed necessary.

Once the source of error has been identified and data are corrected, the supervisor informs, through a written report, the Quality Assurance Officer of the reason for the error, describes what measures were taken to eliminate the problem, and points out which samples and reference materials were re-analyzed.

5. References

1. EPA Handbook for Analytical Quality Control in Water and Wastewater Laboratories, 1979, EPA-600/4-79-019.
2. "Principles of Environmental Analysis," ACS Report, Analytical Chemistry 1983 55, (14), 2210-2218.
3. "Fundamentals of Analytical Chemistry," D. A. Skoog and D. M. West, 4th edition, Saunders College Publishing, NY, 1982, Chapter 3.
4. "Minimum Quality Assurance Requirements for Water Monitoring Laboratories," Revision 1, March, 1982, EPA R8-QA0-82-MR-03.
5. "Standard Methods for the Examination of Water and Wastewater," 15th edition, American Public Health Assoc., Washington, DC, 1980.
6. "Validation of Analytical Methods," Taylor, J. K. Analytical Chem., 1983, 55, (6), 600-604.
7. "Quality Assurance of Chemical Measurements," Taylor, J. K. Analytical Chem., 1981, 55, (14), 1588-1596.
8. "Sampling for Chemical Analysis," Byron Kratochvil and J. K. Taylor, Analytical Chem., 1981, 53, (8), 924-937.

6. Definitions

Definitions of some commonly used terms are provided below. (References 1-3.)

Accuracy - Refers to how close a measurement is to the true value, usually difficult to measure.

Confidence Limit - A tool used to gauge precision of a measurement. Usually expressed for normal populations with independent samples as the mean $\bar{x} \pm ts/\sqrt{n}$, where t is the Student t value determined by the degrees of freedom $(n-1)$ for n measurements with standard deviations s . A small table of t values at the 95% confidence limit usually used is provided below:

$(n-1)$	1	2	3	4	5	6	7	8	9	10	15	∞
t	12.7	4.30	3.18	2.78	2.57	2.45	2.36	2.31	2.26	2.23	2.13	1.96

Mean - An average value defined as the \bar{x} of a series of n measurements x_i :

$$\bar{x} = \frac{\sum_{i=1}^n x_i}{n}$$

Outliers - Results that are so far from the mean that they are probably not valid.

Precision - Refers to the degree to which replicate measurements vary.

Protocol - The structuring of the analytical program sequence, including sampling procedures, measurements, method challenging, and documentation.

Quality Assessment - A process used to confirm that the analytical protocol is operating within required limits.

Quality Assurance - The process designed to ensure that the quality control program is operating and that the analytical results are most likely correct within the defined limits of methodologies.

Quality Control - A program designed to minimize errors in analytical data.

Relative Standard Deviation - The standard deviations s divided by the mean \bar{x} ; sometimes expressed as percent.

Repeatability - Refers to precision of a method run within a laboratory.

Reproducibility - Refers to precision of a method run by different laboratories.

Standard Deviation - A tool used to describe the spread of distribution for data. Defined as follows for a finite population as a function of the mean \bar{x} of a series of measurements x_i and degrees of freedom $(n-1)$

for n measurements:

$$s = \sqrt{\frac{\sum_{i=1}^n (\bar{x} - x_i)^2}{(n-1)}}$$

Validation - A mechanism for studying the applicability of methodology using reference materials analyzed by several laboratories.

Verification - A mechanism used to check a method's ability to generate quality data.

ATTACHMENT B
WESTERN RESEARCH INSTITUTE
LABORATORY TEST DATA

ATTACHMENT B.1
LABORATORY TEST DATA
METHOD BLANK

WESTERN RESEARCH INSTITUTE
Analytical Services Division
Organic Data Sheet
(Volatile Organics)

Client: JCR Consultants, Inc.

Name & Address: 8000 East Girard Ave.

Sample ID: Water Blank-VOA ^{Denver Co 80231}

Sample Type: Water

Sample Description: _____

Submitted By: John Reiss Jr.

WRIST ACN#: _____

Date Submitted: 9-6-85

Report Date: 9-24-85

Date Analyzed: 9-12-85

Requested Analysis: _____

CAS Number	Compound	<u>ug/l</u> or ug/Kg	CAS Number	Compound	<u>ug/l</u> or ug/Kg
74-87-3	chloromethane	<u>10u</u>	79-34-5	1,1,2,2-tetrachloroethane	<u>5u</u>
74-83-9	bromomethane	<u>10u</u>	78-87-5	1,2-dichloropropane	<u>5u</u>
75-01-4	vinyl chloride	<u>10u</u>	10061-0206	trans-1,3-dichloropropene	<u>5u</u>
75-00-3	chloroethane	<u>10u</u>	79-01-6	trichloroethene	<u>5u</u>
75-09-2	methylene chloride	<u>2.8J</u>	124-48-1	dibromochloromethane	<u>5u</u>
67-64-1	acetone	<u>9.5J</u>	79-00-5	1,1,2-trichloroethane	<u>5u</u>
75-15-0	carbon disulfide	<u>5u</u>	71-43-2	benzene	<u>5u</u>
75-35-4	1,1-dichloroethene	<u>5u</u>	10061-01-5	cis-1,3-dichloropropene	<u>5u</u>
75-34-3	1,1-dichloroethane	<u>5u</u>	110-75-8	2-chloroethylvinylether	<u>10u</u>
156-60-5	trans-1,2-dichloroethene	<u>5u</u>	75-25-2	bromoform	<u>5u</u>
67-66-3	chloroform	<u>5u</u>	591-78-6	2-hexanone	<u>10u</u>
107-06-2	1,2-dichloroethane	<u>5u</u>	108-10-1	4-methyl-2-pentanone	<u>10u</u>
78-93-3	2-butanone	<u>10u</u>	127-18-4	tetrachloroethene	<u>5u</u>
71-55-6	1,1,1-trichloroethane	<u>5u</u>	108-88-3	toluene	<u>0.78J</u>
56-23-5	carbon tetrachloride	<u>5u</u>	108-90-7	chlorobenzene	<u>5u</u>
108-05-4	vinyl acetate	<u>10u</u>	100-41-4	ethylbenzene	<u>5u</u>
75-27-4	bromodichloromethane	<u>5u</u>	100-42-5	styrene	<u>5u</u>
				total xylenes	<u>5u</u>

Comments:

Approved By: L. Baughman

Qualifier Statement: File > WB 27: 9-12-85

J: below detection limits; estimated value

u: analyzed for but undetected; number indicates detection limit

Analytical Services Division
Organic Data Sheet
(Semi-Volatile Organics)

Client: JCR Consultants, Inc 8000 Girard Ave.
Name & Address: Denver, CO. 80231

Sample ID: Method Blank Sample type: BNA

Sample Description: Water Submitted By:

WRIST ACN#: Date Submitted:

Report Date: 10-10-85

Requested Analysis: EPA 625

CAS Number	Compound	ug/l or ug/Kg	CAS Number	Compound	ug/l or ug/Kg
62-75-9	N-nitrosodimethylamine	21u	88-75-5	2-nitrophenol	21u
108-95-2	phenol	21u	105-67-9	2, 4-dimethylphenol	101u
62-53-3	aniline	21u	65-85-0	benzoic acid	21u
111-44-4	bis(-2-chloroethyl)ether	21u	111-91-1	bis(-2-chloroethoxy)methane	21u
95-57-8	2 chlorophenol	21u	120-83-2	2, 4-dichlorophenol	21u
541-73-1	1, 3-dichlorobenzene	21u	120-82-1	1, 2, 4-trichlorobenzene	21u
106-46-7	1, 4-dichlorobenzene	21u	91-20-3	naphthalene	21u
100-51-6	benzyl alcohol	21u	106-47-8	4-chloroaniline	101u
95-50-1	1, 2-dichlorobenzene	21u	87-68-3	hexachlorobutadiene	21u
95-48-7	2-methylphenol	21u	59-50-7	4-chloro-3-methylphenol	21u
39638-32-9	bis (2-chloroisopropyl) ether	21u	91-57-6	2-methylnaphthalene	21u
106-44-5	4-methylphenol	21u	77-47-4	hexachlorocyclopentadiene	21u
621-64-7	N-nitroso-di-n-propylamine	21u	88-06-2	2,4,6-trichlorophenol	21u
67-72-1	hexachloroethane	21u	95-95-4	2,4,5-trichlorophenol	101u
98-95-3	nitrobenzene	21u	91-58-7	2-chloronaphthalene	21u
78-59-1	isophorone	21u	88-74-4	2-nitroaniline	21u
			131-11-3	dimethyl phthalate	21u
			208-96-8	acenaphthylene	21u
			99-09-2	3-nitroaniline	10u

Comments:

Approved By: 

Qualifier Statement: B: found in water blank
J: estimated concentration; below detection limits
u: analyzed for but not detected, value indicates detection limits

Analytical Services Division
Organic Data Sheet
(Semi-Volatile Organics)

Client: JCR Consultants, Inc
Name & Address:

8000 Girard Ave.
Denver, CO 80231

Sample ID: Method Blank Sample type: BNA

Sample Description: Water Submitted By:

WRIST ACN#: Date Submitted:

Report Date: 10-10-85

Requested Analysis: EPA 625

CAS Number	Compound	ug/L or ug/Kg	CAS Number	Compound	ug/L or ug/Kg
83-32-9	acenaphthene	21u	85-01-8	phenanthrene	21u
51-28-5	2,4-dinitrophenol	101u	120-12-7	anthracene	21u
100-02-7	4-nitrophenol	101u	84-74-2	di-n-butylphthalate	21u
132-64-9	dibenzofuran	21u	206-44-0	fluoranthene	21u
121-14-2	2, 4-dinitrotoluene	21u	92-87-5	benzidine	101u
606-20-2	2, 6-dinitrotoluene	21u	129-00-0	pyrene	21u
84-66-2	diethylphthalate	21u	85-68-7	butylbenzylphthalate	21u
7005-72-3	4-chlorophenyl-phenylether	21u	91-94-1	3, 3-dichlorobenzoin	42u
86-73-7	fluorene	21u	56-55-3	benzo(a)anthracene	21u
100-01-6	4-nitroaniline	101u	117-81-7	bis(2-ethylhexyl)phthalate	10J
534-52-1	4, 6-dinitro-2-methylphenol	101u	218-01-9	chrysene	21u
86-30-6	n-nitrosodiphenylamine (1)	21u	117-84-0	di-n-octyl phthalate	21u
101-55-3	4-bromophenyl-phenylether	21u	205-99-2	benzo(b)fluoranthene	21u
118-74-1	hexachlorobenzene	21u	207-08-9	benzo(k)fluoranthene	21u
87-86-5	pentachlorophenol	101u	50-32-8	benzo(a)pyrene	21u
			193-39-5	indeno(1,2,3-cd)pyrene	21u
			53-70-3	dibenzo(a,h)anthracene	21u
			191-24-2	benzo(c,h,i)perylene	21u

Comments:

Approved By: 

Qualifier Statement: B: found in water blank
J: estimated concentration; below detection limits
u: analyzed for but not detected, value indicates detection limits

ATTACHMENT B.2
LABORATORY TEST DATA
FIELD BLANK

WESTERN RESEARCH INSTITUTE
Analytical Services Division (
Organic Data Sheet
(Volatile Organics)

Client: JCR Consultants, Inc.

Name & Address: 8000 East Girard Ave.

Sample ID: Field Blank ^{Denver, Co. 80231}

Sample Type: Water

Sample Description: Field Blank: Water Submitted By: John Reiss Jr.

WRIST ACN#: 5230

Date Submitted: 9-6-85

Report Date: 9-24-85

Date Analyzed: 9-12-85

Requested Analysis: VOA

CAS Number	Compound	<u>ug/l</u> or <u>ug/kg</u>	CAS Number	Compound	<u>ug/l</u> or <u>ug/kg</u>
74-87-3	chloromethane	10u	79-34-5	1,1,2,2-tetrachloroethane	5u
74-83-9	bromomethane	10u	78-87-5	1,2-dichloropropane	5u
75-01-4	vinyl chloride	10u	10061-0206	trans-1,3-dichloropropene	5u
75-00-3	chloroethane	10u	79-01-6	trichloroethene	5u
75-09-2	methylene chloride	5u	124-48-1	dibromochloromethane	5u
67-64-1	acetone	20B	79-00-5	1,1,2-trichloroethane	5u
75-15-0	carbon disulfide	5u	71-43-2	benzene	5u
75-35-4	1,1-dichloroethene	5u	10061-01-5	cis-1,3-dichloropropene	5u
75-34-3	1,1-dichloroethane	5u	110-75-8	2-chloroethylvinylether	10u
156-60-5	trans-1,2-dichloroethene	5u	75-25-2	bromoform	5u
67-66-3	chloroform	5u	591-78-6	2-hexanone	10u
107-06-2	1,2-dichloroethane	5u	108-10-1	4-methyl-2-pentanone	10u
78-93-3	2-butanone	10u	127-18-4	tetrachloroethene	5u
71-55-6	1,1,1-trichloroethane	1-3J	108-88-3	toluene	0.57J, B
56-23-5	carbon tetrachloride	5u	108-90-7	chlorobenzene	5u
108-05-4	vinyl acetate	10u	100-41-4	ethylbenzene	5u
75-27-4	bromodichloromethane	5u	100-42-5	styrene	5u
				Total xylenes	5u

Comments:

Approved By: 

Qualifier Statement:

File > JCR 02: 9-12-85

J: below detection limits; estimated value

u: analyzed for but not detected: number indicates detection limits

B: detected in water blank

**Analytical Services Division
Organic Data Sheet
(Semi-Volatile Organics)**

Client: JCR Consultants, Inc. 8000 East Girard Ave.
Name & Address: Denver, Co. 80231

Sample ID: Field Blank Sample Type: BNA

Sample Description: Water Submitted By: John Reiss Jr.

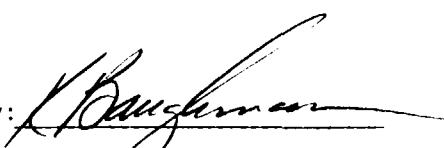
WRIST ACN#: 5236 Date Submitted: 9-6-85

Report Date: 10-11-85

Requested Analysis: BNA-625CLP

CAS Number	Compound	ug/l or ug/Kg	CAS Number	Compound	ug/l or ug/Kg
83-32-9	acenaphthene	69	85-01-8	phenanthrene	20u
51-28-5	2,4-dinitrophenol	100u	120-12-7	anthracene	20u
100-02-7	4-nitrophenol	100u	84-74-2	di-n-butylphthalate	20u
132-64-9	dibenzofuran	20u	206-44-0	fluoranthene	20u
121-14-2	2, 4-dinitrotoluene	81	92-87-5	benzidine	100u
606-20-2	2, 6-dinitrotoluene	20u	129-00-0	pyrene	70
84-66-2	diethylphthalate	20u	85-68-7	butylbenzylphthalate	20u
7005-72-3	4-chlorophenyl-phenylether	20u	91-94-1	3, 3-dichlorobenzoine	40u
86-73-7	fluorene	20u	56-55-3	benzo(a)anthracene	20u
100-01-6	4-nitroaniline	100u	117-81-7	bis(2-ethylhexyl)phthalate	13
534-52-1	4, 6-dinitro-2-methylphenol	100u	218-01-9	chrysene	20u
86-30-6	n-nitrosodiphenylamine (1)	20u	117-84-0	di-n-octyl phthalate	20u
101-55-3	4-bromophenyl-phenylether	20u	205-99-2	benzo(b)fluoranthene	20u
118-74-1	hexachlorobenzene	20u	207-08-9	benzo(k)fluoranthene	20u
87-86-5	pentachlorophenol	100u	50-32-8	benzo(a)pyrene	20u
			193-39-5	indeno(1,2,3-cd)pyrene	20u
			53-70-3	dibenzo(a,h)anthracene	20u
			191-24-2	benzo(c,h,i)perylene	20u

Comments:

Approved By: 

Qualifier Statement: File > JCR: 9-12-85

B: detected in water blank

J: below detection limits; estimated value

u: analyzed for but undetected: number indicates detection limits

Analytical Services Division
Organic Data Sheet
(Semi-Volatile Organics)

Client: JCR Consultants, Inc.
Name & Address:

8000 East Girard Ave.
Denver, Co. 80231

Sample ID: Field Blank

Sample Type: BNA

Sample Description: Water

Submitted By: John Reiss Jr.

WRIST ACN#: 5236


Date Submitted: 9-6-85

Report Date: 10-11-85

Requested Analysis: CLP-625

CAS Number	Compound	(ug/l) or ug/Kg	CAS Number	Compound	(ug/l) or ug/Kg
62-75-9	N-nitrosodimethylamine	20u	88-75-5	2-nitrophenol	20u
108-95-2	phenol	9.4u	105-67-9	2, 4-dimethylphenol	20u
62-53-3	aniline	20u	65-85-0	benzoic acid	100u
111-44-4	bis(-2-chloroethyl)ether	20u	111-91-1	bis(-2-chloroethoxy)methane	20u
95-57-8	2 chlorophenol	3.16	120-83-2	2, 4-dichlorophenol	20u
541-73-1	1, 3-dichlorobenzene	20u	120-82-1	1, 2, 4-trichlorobenzene	63
106-46-7	1, 4-dichlorobenzene	68	91-20-3	naphthalene	20u
100-51-6	benzyl alcohol	20u	106-47-8	4-chloroaniline	20u
95-50-1	1, 2-dichlorobenzene	20u	87-68-3	hexachlorobutadiene	20u
95-48-7	2-methylphenol	20u	59-50-7	4-chloro-3-methylphenol	37
39638-32-9	bis (2-chloroisopropyl) ether	20u	91-57-6	2-methylnaphthalene	20u
106-44-5	4-methylphenol	20u	77-47-4	hexachlorocyclopentadiene	20u
621-64-7	N-nitroso-di-n-propylamine	60	88-06-2	2,4,6-trichlorophenol	20u
67-72-1	hexachloroethane	20u	95-95-4	2,4,5-trichlorophenol	100u
98-95-3	nitrobenzene	20u	91-58-7	2-chloronaphthalene	20u
78-59-1	isophorone	20u	88-74-4	2-nitroaniline	100u
			131-11-3	dimethyl phthalate	20u
			208-96-8	acenaphthylene	20u
			99-09-2	3-nitroaniline	100u

Comments:

Approved By: 

Qualifier Statement: File > JCR 05: 9-12-85

B: detected in water blank

J: below detection limits; estimated value

u: analyzed for but undetected: number indicates detection limits

ATTACHMENT B.3
LABORATORY TEST DATA
MONITOR WELL MW-10

WESTERN RESEARCH INSTITUTE
Analytical Services Division
Organic Data Sheet
(Volatile Organics)

Client: JCR Consultants, Inc.

Name & Address: 8000 East Girard Ave.

Sample ID: DW-10 Denver, Co. 80231

Sample Type: Water

Sample Description: Water

Submitted By: John Reiss Jr.

WRIST ACN#: 5227

Date Submitted: 9-6-85

Report Date: 9-24-85

Date Analyzed: 9-12-85

Requested Analysis: VOA

CAS Number	Compound	<u>ug/l</u> or ug/Kg	CAS Number	Compound	<u>ug/l</u> or ug/Kg
74-87-3	chloromethane	<u>10u</u>	79-34-5	1,1,2,2-tetrachloroethane	<u>5u</u>
74-83-9	bromomethane	<u>10u</u>	78-87-5	1,2-dichloropropane	<u>5u</u>
75-01-4	vinyl chloride	<u>10u</u>	10061-0206	trans-1,3-dichloropropene	<u>5u</u>
75-00-3	chloroethane	<u>10u</u>	79-01-6	trichloroethene	<u>60</u>
75-09-2	methylene chloride	<u>5u</u>	124-48-1	dibromochloromethane	<u>5u</u>
67-64-1	acetone	<u>16B</u>	79-00-5	1,1,2-trichloroethane	<u>2.0J</u>
75-15-0	carbon disulfide	<u>133</u>	71-43-2	benzene	<u>5u</u>
75-35-4	1,1-dichloroethene	<u>5.0</u>	10061-01-5	cis-1,3-dichloropropene	<u>5u</u>
75-34-3	1,1-dichloroethane	<u>5u</u>	110-75-8	2-chloroethylvinylether	<u>10u</u>
156-60-5	trans-1,2-dichloroethene	<u>3.5J</u>	75-25-2	bromoform	<u>5u</u>
67-66-3	chloroform	<u>5u</u>	591-78-6	2-hexanone	<u>10u</u>
107-06-2	1,2-dichloroethane	<u>5u</u>	108-10-1	4-methyl-2-pentanone	<u>10u</u>
78-93-3	2-butanone	<u>10u</u>	127-18-4	tetrachloroethene	<u>43</u>
71-55-6	1,1,1-trichloroethane	<u>680</u>	108-88-3	toluene	<u>0.5J, B</u>
56-23-5	carbon tetrachloride	<u>5u</u>	108-90-7	chlorobenzene	<u>5u</u>
108-05-4	vinyl acetate	<u>10u</u>	100-41-4	ethylbenzene	<u>5u</u>
75-27-4	bromodichloromethane	<u>5u</u>	100-42-5	styrene	<u>5u</u>
				Total xylenes	<u>5u</u>

Comments:

Approved By: [Signature]

Qualifier Statement: File > JCR 01 9-12-85

J: below detection limits; estimated value

u: analyzed for but not detected; number indicated detection limits

B: detected in water blank

ANALYTICAL SERVICES DIVISION
Organic Data Sheet
(Semi-Volatile Organics)

Client: JCR Consultants, Inc.
Name & Address:

8000 East Girard Ave.
Denver, CO. 80231

Sample ID: MW-10

Sample Type: BNA

Sample Description: Water

Submitted By: John Reiss Jr.

WRIST ACN#: 5233

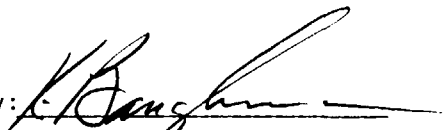
Date Submitted: 9-6-85

Report Date: 10-10-85

Requested Analysis: CLP 625

CAS Number	Compound	(ug/l) or ug/Kg	CAS Number	Compound	(ug/l) or ug/Kg
62-75-9	N-nitrosodimethylamine	20u	88-75-5	2-nitrophenol	20u
108-95-2	phenol	20u	105-67-9	2, 4-dimethylphenol	20u
62-53-3	aniline	20u	65-85-0	benzoic acid	100u
111-44-4	bis(-2-chloroethyl)ether	20u	111-91-1	bis(-2-chloroethoxy)methane	20u
95-57-8	2 chlorophenol	20u	120-83-2	2, 4-dichlorophenol	20u
541-73-1	1, 3-dichlorobenzene	20u	120-82-1	1, 2, 4-trichlorobenzene	20u
106-46-7	1, 4-dichlorobenzene	20u	91-20-3	naphthalene	20u
100-51-6	benzyl alcohol	20u	106-47-8	4-chloroaniline	20u
95-50-1	1, 2-dichlorobenzene	20u	87-68-3	hexachlorobutadiene	20u
95-48-7	2-methylphenol	20u	59-50-7	4-chloro-3-methylphenol	20u
39638-32-9	bis (2-chloroisopropyl) ether	20u	91-57-6	2-methylnaphthalene	20u
106-44-5	4-methylphenol	20u	77-47-4	hexachlorocyclopentadiene	20u
621-64-7	N-nitroso-di-n-propylamine	20u	88-06-2	2,4,6-trichlorophenol	20u
67-72-1	hexachloroethane	20u	95-95-4	2,4,5-trichlorophenol	100u
98-95-3	nitrobenzene	20u	91-58-7	2-chloronaphthalene	20u
78-59-1	isophorone	20u	88-74-4	2-nitroaniline	100u
			131-11-3	dimethyl phthalate	20u
			208-96-8	acenaphthylene	20u
			99-09-2	3-nitroaniline	100u

Comments:

Approved By: 

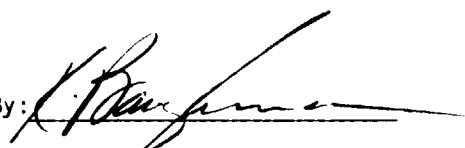
Qualifier Statement: B: detected in water blank
J: below detection limits; estimated value
u: analyzed for but undetected; number indicates detection limits

**Analytical Services Division
Organic Data Sheet
(Semi-Volatile Organics)**

Client: JCR Consultants, Inc. 8000 East Girard Ave.
Name & Address: Denver, CO. 80231
Sample ID: MW-10 Sample Type: BNA
Sample Description: Water Submitted By: John Reiss Jr.
WRIST ACN#: 5233 Date Submitted: 9-6-85
Report Date: 10-10-85
Requested Analysis: CLP 625

CAS Number	Compound	(ug/l) or ug/Kg	CAS Number	Compound	(ug/l) or ug/Kg
83-32-9	acenaphthene	20u	85-01-8	phenanthrene	20u
51-28-5	2,4-dinitrophenol	100u	120-12-7	anthracene	20u
100-02-7	4-nitrophenol	20u	84-74-2	di-n-butylphthalate	20u
132-64-9	dibenzofuran	20u	206-44-0	fluoranthene	20u
121-14-2	2, 4-dinitrotoluene	20u	92-87-5	benzidine	100u
606-20-2	2, 6-dinitrotoluene	20u	129-00-0	pyrene	20u
84-66-2	diethylphthalate	20u	85-68-7	butylbenzylphthalate	20u
7005-72-3	4-chlorophenyl-phenylether	20u	91-94-1	3, 3-dichlorobenzoine	40u
86-73-7	fluorene	20u	56-55-3	benzo(a)anthracene	20u
100-01-6	4-nitroaniline	100u	117-81-7	bis(2-ethylhexyl)phthalate	9.6B
534-52-1	4, 6-dinitro-2-methylphenol	100u	218-01-9	chrysene	20u
86-30-6	n-nitrosodiphenylamine (1)	20u	117-84-0	di-n-octyl phthalate	20u
101-55-3	4-bromophenyl-phenylether	20u	205-99-2	benzo(b)fluoranthene	20u
118-74-1	hexachlorobenzene	20u	207-08-9	benzo(k)fluoranthene	20u
87-86-5	pentachlorophenol	100u	50-32-8	benzo(a)pyrene	4.3J
			193-39-5	indeno(1,2,3-cd)pyrene	20u
			53-70-3	dibenzo(a,h)anthracene	20u
			191-24-2	benzo(c,h,i)perylene	20u

Comments:

Approved By: 

Qualifier Statement:

B: detected in water blank
J: below detection limits; estimated value
u: analyzed for but undetected; number indicates detection limits

ATTACHMENT B.4
LABORATORY TEST DATA
MONITOR WELL MW-13

**WESTERN RESEARCH INSTITUTE
Analytical Services Division (**
Organic Data Sheet
(Volatile Organics)

Client: JCR Consultants, Inc

Name & Address: 8000 East Girard Ave.

Sample ID: MW-13-1 ^{Denver, Co. 80231}

Sample Type: Water

Sample Description: Water

Submitted By: John Reiss Jr.

WRIST ACN#: 5225

Date Submitted: 9-6-85

Report Date: 9-24-85

Date Analyzed: 9-12-85

Requested Analysis: VOA

CAS Number	Compound	<u>ug/l</u> or <u>ug/Kg</u>	CAS Number	Compound	<u>ug/l</u> or <u>ug/Kg</u>
74-87-3	chloromethane	<u>10u</u>	79-34-5	1,1,2,2-tetrachloroethane	<u>5u</u>
74-83-9	bromomethane	<u>10u</u>	78-87-5	1,2-dichloropropane	<u>5u</u>
75-01-4	vinyl chloride	<u>10u</u>	10061-0206	trans-1,3-dichloropropene	<u>5u</u>
75-00-3	chloroethane	<u>10u</u>	79-01-6	trichloroethene	<u>5u</u>
75-09-2	methylene chloride	<u>10u, B</u>	124-48-1	dibromochloromethane	<u>5u</u>
67-64-1	acetone	<u>26B</u>	79-00-5	1,1,2-trichloroethane	<u>5u</u>
75-15-0	carbon disulfide	<u>5u</u>	71-43-2	benzene	<u>5u</u>
75-35-4	1,1-dichloroethene	<u>5u</u>	10061-01-5	cis-1,3-dichloropropene	<u>5u</u>
75-34-3	1,1-dichloroethane	<u>5u</u>	110-75-8	2-chloroethylvinylether	<u>10u</u>
156-60-5	trans-1,2-dichloroethene	<u>5u</u>	75-25-2	bromoform	<u>5u</u>
67-66-3	chloroform	<u>5u</u>	591-78-6	2-hexanone	<u>10u</u>
107-06-2	1,2-dichloroethane	<u>5u</u>	108-10-1	4-methyl-2-pentanone	<u>10u</u>
78-93-3	2-butanone	<u>10u</u>	127-18-4	tetrachloroethene	<u>5u</u>
71-55-6	1,1,1-trichloroethane	<u>5u</u>	108-88-3	toluene	<u>0.49J, B</u>
56-23-5	carbon tetrachloride	<u>5u</u>	108-90-7	chlorobenzene	<u>5u</u>
108-05-4	vinyl acetate	<u>10u</u>	100-41-4	ethylbenzene	<u>5u</u>
75-27-4	bromodichloromethane	<u>5u</u>	100-42-5	styrene	<u>5u</u>
				Total xylenes	<u>5u</u>

Comments:

Approved By: [Signature]

Qualifier Statement: File > JCR 03: 9-12-85

J: below detection limits; estimated value

B: detected in water blank

u: analyzed for but undetected; number indicates detection limit

WESTERN RESEARCH INSTITUTE
Analytical Services Division
Organic Data Sheet
(Volatile Organics)

Client: JCR Consultants, Inc.

Name & Address: 8000 East Girard Ave.

Denver, Co. 80231

Sample ID: MW-13-2

Sample Type: Water

Sample Description: Water

Submitted By: John Reiss Jr.

WRIST ACN#: 5226

Date Submitted: 9-6-85

Report Date: 9-24-85

Date Analyzed: 9-12-85

Requested Analysis: VOA

CAS Number	Compound	ug/l or ug/Kg	CAS Number	Compound	ug/l or ug/Kg
74-87-3	chloromethane	10u	79-34-5	1,1,2,2-tetrachloroethane	5u
74-83-9	bromomethane	10u	78-87-5	1,2-dichloropropane	5u
75-01-4	vinyl chloride	10u	10061-0206	trans-1,3-dichloropropene	5u
75-00-3	chloroethane	10u	79-01-6	trichloroethene	5u
75-09-2	methylene chloride	5u	124-48-1	dibromochloromethane	5u
67-64-1	acetone	12.6B	79-00-5	1,1,2-trichloroethane	5u
75-15-0	carbon disulfide	5u	71-43-2	benzene	5u
75-35-4	1,1-dichloroethene	5u	10061-01-5	cis-1,3-dichloropropene	5u
75-34-3	1,1-dichloroethane	5u	110-75-8	2-chloroethylvinylether	10u
156-60-5	trans-1,2-dichloroethene	5u	75-25-2	bromoform	5u
67-66-3	chloroform	5u	591-78-6	2-hexanone	10u
107-06-2	1,2-dichloroethane	5u	108-10-1	4-methyl-2-pentanone	10u
78-93-3	2-butanone	10u	127-18-4	tetrachloroethene	5u
71-55-6	1,1,1-trichloroethane	5u	108-88-3	toluene	5u
56-23-5	carbon tetrachloride	5u	108-90-7	chlorobenzene	5u
108-05-4	vinyl acetate	10u	100-41-4	ethylbenzene	5u
75-27-4	bromodichloromethane	5u	100-42-5	styrene	5u
				total xylenes	5u

Comments:

Approved By: 

Qualifier Statement: File > JCR 04: 9-12-85

u: analyzed for but undetected; number indicates detection limits

B: detected in water blank

J: below detection limits; estimated value

ANALYTICAL SERVICES DIVISION
Organic Data Sheet
(Semi-Volatile Organics)

Client: JCR Consultants, Inc. 8000 East Girard Ave.
Name & Address: Denver, CO 80231

Sample ID: MW-13 Sample Type: BNA

Sample Description: Water Submitted By: John Reiss Jr.

WRIST ACN#: 5232 Date Submitted: 9-6-85

Report Date: 10-10-85

Requested Analysis: CLP 625

CAS Number	Compound	ug/l or ug/kg	CAS Number	Compound	ug/l or ug/kg
62-75-9	N-nitrosodimethylamine	20u	88-75-5	2-nitrophenol	20u
108-95-2	phenol	20u	105-67-9	2, 4-dimethylphenol	20u
62-53-3	aniline	20u	65-85-0	benzoic acid	100u
111-44-4	bis(-2-chloroethyl)ether	20u	111-91-1	bis(-2-chloroethoxy)methane	20u
95-57-8	2 chlorophenol	20u	120-83-2	2, 4-dichlorophenol	20u
541-73-1	1, 3-dichlorobenzene	20u	120-82-1	1, 2, 4-trichlorobenzene	20u
106-46-7	1, 4-dichlorobenzene	20u	91-20-3	naphthalene	20u
100-51-6	benzyl alcohol	20u	106-47-8	4-chloroaniline	20u
95-50-1	1, 2-dichlorobenzene	20u	87-68-3	hexachlorobutadiene	20u
95-48-7	2-methylphenol	20u	59-50-7	4-chloro-3-methylphenol	20u
39638-32-9	bis (2-chloroisopropyl) ether	20u	91-57-6	2-methylnaphthalene	20u
106-44-5	4-methylphenol	20u	77-47-4	hexachlorocyclopentadiene	20u
621-64-7	N-nitroso-di-n-propylamine	20u	88-06-2	2,4,6-trichlorophenol	20u
67-72-1	hexachloroethane	20u	95-95-4	2,4,5-trichlorophenol	100u
98-95-3	nitrobenzene	20u	91-58-7	2-chloronaphthalene	20u
78-59-1	isophorone	20u	88-74-4	2-nitroaniline	100u
			131-11-3	dimethyl phthalate	20u
			208-96-8	acenaphthylene	20u
			99-09-2	3-nitroaniline	100u

Comments:

Approved By: 

Qualifier Statement: B: detected in water blank
J: below detection limits; estimated value
u: analyzed for but undetected; number indicates detection limits

**Analytical Services Division
Organic Data Sheet
(Semi-Volatile Organics)**

Client: JCR Consultants, Inc.
Name & Address:

8000 East Girard Ave.
Denver, CO 80231

Sample ID: MW-13

Sample Type: BNA

Sample Description: Water

Submitted By: John Reiss Jr.

WRIST ACN#: 5232

Date Submitted: 9-6-85

Report Date: 10-10-85

Requested Analysis: CLP 625

CAS Number	Compound	(ug/l) or ug/Kg	CAS Number	Compound	(ug/l) or ug/Kg
83-32-9	acenaphthene	<u>20u</u>	85-01-8	phenanthrene	<u>20u</u>
51-28-5	2,4-dinitrophenol	<u>100u</u>	120-12-7	anthracene	<u>20u</u>
100-02-7	4-nitrophenol	<u>100u</u>	84-74-2	di-n-butylphthalate	<u>20u</u>
132-64-9	dibenzofuran	<u>20u</u>	206-44-0	fluoranthene	<u>20u</u>
121-14-2	2, 4-dinitrotoluene	<u>20u</u>	92-87-5	benzidine	<u>100u</u>
606-20-2	2, 6-dinitrotoluene	<u>20u</u>	129-00-0	pyrene	<u>20u</u>
84-66-2	diethylphthalate	<u>20u</u>	85-68-7	butylbenzylphthalate	<u>20u</u>
7005-72-3	4-chlorophenyl-phenylether	<u>20u</u>	91-94-1	3, 3-dichlorobenzoine	<u>40u</u>
86-73-7	fluorene	<u>20u</u>	56-55-3	benzo(a)anthracene	<u>20u</u>
100-01-6	4-nitroaniline	<u>100u</u>	117-81-7	bis(2-ethylhexyl)phthalate	<u>28B</u>
534-52-1	4, 6-dinitro-2-methylphenol	<u>100u</u>	218-01-9	chrysene	<u>20u</u>
86-30-6	n-nitrosodiphenylamine (1)	<u>20u</u>	117-84-0	di-n-octyl phthalate	<u>20u</u>
101-55-3	4-bromophenyl-phenylether	<u>20u</u>	205-99-2	benzo(b)fluoranthene	<u>20u</u>
118-74-1	hexachlorobenzene	<u>20u</u>	207-08-9	benzo(k)fluoranthene	<u>20u</u>
87-86-5	pentachlorophenol	<u>100u</u>	50-32-8	benzo(a)pyrene	<u>10u</u>
			193-39-5	indeno(1,2,3-cd)pyrene	<u>20u</u>
			53-70-3	dibenzo(a,h)anthracene	<u>20u</u>
			191-24-2	benzo(c,h,i)perylene	<u>20u</u>

Comments: The bis (ethylhexyl) phthalate present in the blank.
The benzo (a) pyrene was below the detection limit, but a good mass spectral match was obtained.

Approved By: 

Qualifier Statement: B: detected in water blank
J: below detection limits; estimated value
u: analyzed for but undetected; number indicates detection limits

ATTACHMENT B.5
LABORATORY TEST DATA
MONITOR WELL MW-17

WESTERN RESEARCH INSTITUTE
Analytical Services Division
Organic Data Sheet
(Volatile Organics)

Client: JCR Consultants, Inc

Name & Address: 8000 East Girard Ave.

Sample ID: MW-17 Denver, Co. 80231

Sample Type: Water

Sample Description: Water

Submitted By: John Reiss Jr.

WRIST ACN#: 5229

Date Submitted: 9-6-85

Report Date: 9-24-85

Date Analyzed: 9-12-85

Requested Analysis: VOA

CAS Number	Compound	ug/l or ug/Kg	CAS Number	Compound	ug/l or ug/Kg
74-87-3	chloromethane	10u	79-34-5	1,1,2,2-tetrachloroethane	5u
74-83-9	bromomethane	10u	78-87-5	1,2-dichloropropane	5u
75-01-4	vinyl chloride	10u	10061-0206	trans-1,3-dichloropropene	5u
75-00-3	chloroethane	10u	79-01-6	trichloroethene	5u
75-09-2	methylene chloride	5u	124-48-1	dibromochloromethane	5u
67-64-1	acetone	21B	79-00-5	1,1,2-trichloroethane	5u
75-15-0	carbon disulfide	5u	71-43-2	benzene	5u
75-35-4	1,1-dichloroethene	5u	10061-01-5	cis-1,3-dichloropropene	5u
75-34-3	1,1-dichloroethane	5u	110-75-8	2-chloroethylvinylether	10u
156-60-5	trans-1,2-dichloroethene	5u	75-25-2	bromoform	5u
67-66-3	chloroform	5u	591-78-6	2-hexanone	10u
107-06-2	1,2-dichloroethane	5u	108-10-1	4-methyl-2-pentanone	10u
78-93-3	2-butanone	10u	127-18-4	tetrachloroethene	5u
71-55-6	1,1,1-trichloroethane	5u	108-88-3	toluene	0.5B, J
56-23-5	carbon tetrachloride	5u	108-90-7	chlorobenzene	5u
108-05-4	vinyl acetate	10u	100-41-4	ethylbenzene	5u
75-27-4	bromodichloromethane	5u	100-42-5	styrene	5u
				total xylenes	5u

Comments:

Approved By: [Signature]

Qualifier Statement: File > JCR 05: 9-12-85

B: detected in water blank

J: below detection limits; estimated value

u: analyzed for but undetected: number indicates detection limits

Analytical Services Division
Organic Data Sheet
(Semi-Volatile Organics)

Client: JCR Consultants, Inc. 8000 East Girard Ave.
Name & Address: Denver, Co. 80231

Sample ID: MW-17 Sample Type: BNA

Sample Description: Water Submitted By: John Reiss Jr.

WRIST ACN#: 5235 Date Submitted: 9-6-85

Report Date: 10-10-85

Requested Analysis: CLP-625

CAS Number	Compound	ug/l or ug/Kg	CAS Number	Compound	ug/l or ug/Kg
62-75-9	N-nitrosodimethylamine	20u	88-75-5	2-nitrophenol	20u
108-95-2	phenol	20u	105-67-9	2, 4-dimethylphenol	20u
62-53-3	aniline	20u	65-85-0	benzoic acid	3.8u
111-44-4	bis(-2-chloroethyl)ether	20u	111-91-1	bis(-2-chloroethoxy)methane	20u
95-57-8	2 chlorophenol	20u	120-83-2	2, 4-dichlorophenol	20u
541-73-1	1, 3-dichlorobenzene	20u	120-82-1	1, 2, 4-trichlorobenzene	20u
106-46-7	1, 4-dichlorobenzene	20u	91-20-3	naphthalene	20u
100-51-6	benzyl alcohol	20u	106-47-8	4-chloroaniline	20u
95-50-1	1, 2-dichlorobenzene	20u	87-68-3	hexachlorobutadiene	20u
95-48-7	2-methylphenol	20u	59-50-7	4-chloro-3-methylphenol	20u
39638-32-9	bis (2-chloroisopropyl) ether	20u	91-57-6	2-methylnaphthalene	20u
106-44-5	4-methylphenol	20u	77-47-4	hexachlorocyclopentadiene	20u
621-64-7	N-nitroso-di-n-propylamine	20u	88-06-2	2,4,6-trichlorophenol	20u
67-72-1	hexachloroethane	20u	95-95-4	2,4,5-trichlorophenol	100u
98-95-3	nitrobenzene	20u	91-58-7	2-chloronaphthalene	20u
78-59-1	isophorone	20u	88-74-4	2-nitroaniline	100u
			131-11-3	dimethyl phthalate	20u
			208-96-8	acenaphthylene	20u
			99-09-2	3-nitroaniline	100u

Comments: The benzoic acid concentration was below the detection but a good mass spectral match was obtained indicating the presence of this compound.

Approved By: 

Qualifier Statement: B: detected in water blank
J: below detection limits; estimated value
u: analyzed for but undetected: number indicates detection limits

**Analytical Services Division
Organic Data Sheet
(Semi-Volatile Organics)**

Client: JCR Consultants, Inc. 8000 East Girard Ave.
Name & Address: Denver, Co. 80231
Sample ID: MW-17 Sample Type: BNA
Sample Description: Water Submitted By: John Reiss Jr.
WRIST ACN#: 5235 Date Submitted: 9-6-85
Report Date: 10-10-85
Requested Analysis: CLP-625

CAS Number	Compound	<u>ug/l</u> or <u>ug/Kg</u>	CAS Number	Compound	<u>ug/l</u> or <u>ug/Kg</u>
83-32-9	acenaphthene	<u>20u</u>	85-01-8	phenanthrene	<u>20u</u>
51-28-5	2,4-dinitrophenol	<u>100u</u>	120-12-7	anthracene	<u>20u</u>
100-02-7	4-nitrophenol	<u>100u</u>	84-74-2	di-n-butylphthalate	<u>20u</u>
132-64-9	dibenzofuran	<u>20u</u>	206-44-0	fluoranthene	<u>20u</u>
121-14-2	2, 4-dinitrotoluene	<u>20u</u>	92-87-5	benzidine	<u>100u</u>
606-20-2	2, 6-dinitrotoluene	<u>20u</u>	129-00-0	pyrene	<u>20u</u>
84-66-2	diethylphthalate	<u>20u</u>	85-68-7	butylbenzylphthalate	<u>20u</u>
7005-72-3	4-chlorophenyl-phenylether	<u>20u</u>	91-94-1	3, 3-dichlorobenzoine	<u>40u</u>
86-73-7	fluorene	<u>20u</u>	56-55-3	benzo(a)anthracene	<u>20u</u>
100-01-6	4-nitroaniline	<u>100u</u>	117-81-7	bis(2-ethylhexyl)phthalate	<u>9.9B</u>
534-52-1	4, 6-dinitro-2-methylphenol	<u>100u</u>	218-01-9	chrysene	<u>20u</u>
86-30-6	n-nitrosodiphenylamine (1)	<u>20u</u>	117-84-0	di-n-octyl phthalate	<u>20u</u>
101-55-3	4-bromophenyl-phenylether	<u>20u</u>	205-99-2	benzo(b)fluoranthene	<u>20u</u>
118-74-1	hexachlorobenzene	<u>20u</u>	207-08-9	benzo(k)fluoranthene	<u>20u</u>
87-86-5	pentachlorophenol	<u>100u</u>	50-32-8	benzo(a)pyrene	<u>4.2J</u>
			193-39-5	indeno(1,2,3-cd)pyrene	<u>20u</u>
			53-70-3	dibenzo(a,h)anthracene	<u>20u</u>
			191-24-2	benzo(c,h,i)perylene	<u>20u</u>

Comments: The bis(ethylhexyl)phthalate was present in the blank. The benzo (a) pyrene was below detection limits, but a good mass spectral match was obtained indicating the presence of this compound.

Approved By: [Signature]

Qualifier Statement: File > JCR: 9-12-85

B: detected in water blank

J: below detection limits; estimated value

u: analyzed for but undetected: number indicates detection limits

Allen E. Fehr
Joseph G. Graham
Erwin D. Toerber
Quentin H. Davis
Mark K. Young

660 W. Stephenson Street
Freeport, Illinois 61032
815/235-7643



FEHR-GRAHAM
& ASSOCIATES
Consulting Engineers

August 24, 1984

Mr. Mark Chiado
Sundstrand Corporation
Corporate Loss Control
4751 Harrison Avenue
P.O. Box 7003
Rockford, IL 61125

Re: Soils Investigation
at Suntec
Phase I Report

Dear Mark:

Enclosed please find three copies of the Phase I work for the soils investigation at Suntec Industries. If you have any questions, please feel free to contact me.

Very truly yours,

A handwritten signature in cursive script that reads 'Quentin H. Davis'.

Quentin H. Davis

QHD:mr

Enc.

RECEIVED

AUG 27 1984

Loss Control

Introduction

This report is a preliminary report of the Phase I study performed for Suntec Industries, Inc. located at 2210 Harrison Avenue, Rockford, Illinois by Fehr, Graham and Associates, Consulting Engineers, 660 West Stephenson Street, Freeport, Illinois, in accordance with a proposal dated May 29, 1984 for conducting the work.

Scope of Work

The Phase I project consisted of conducting a preliminary investigation to determine if several areas within the facility boundaries contain contaminated soils which would be considered as hazardous per the Resource Conservation and Recovery Act (RCRA) regulations. The results of the preliminary investigation will be used as a basis for recommending further investigation. Following any additional investigations, recommendations for ultimate cleanup and disposal will be made.

Data Collection

A site survey was conducted with Mr. Erich Mueller, Plant Engineer and Mark Chiado, representative of Sundstrand Corporation, Corporate Loss Control. Five sites were selected and agreed upon for sampling and analysis. It was also determined that the samples would be analyzed for EP Toxicity, Volatile Organic Compounds (VOC's) and Total Organic Carbon (TOC). Subsequently, two additional sites were selected as

control (non-contaminated) points for background comparison of TOC. The locations of the seven sampling sites are presented in Figure 1, and a brief description is presented in Table 1.

At each site, a sample was obtained from 2 inches to 6 inches below the ground surface, utilizing an organic free sampling technique. A shovel, prewashed with acetone followed by a distilled water rinse, was used to remove the upper two inches of soil. An organic free stainless steel spoon was used to obtain the sample, which was then placed into a 40 ml glass vial with Teflon septum. Between each sample site, the shovel was cleaned and a new spoon was obtained.

After collection, the sample bottles were immediately chilled in a styrofoam cooler, and subsequently were shipped under ice pack conditions to the laboratory via U.P.S. The laboratory conducting the analysis was CBC-Aquasearch, 140 East Ryan Road, Oak Creek, Wisconsin.

Analysis of Results

The Laboratory Report sheets are presented in Appendix A. Table 2 presents a brief summary of the results.

An analysis of the laboratory reports indicates that most of the samples contained less than the detectable limits of EP toxic metals. Those which were above detectable limits did not exceed the concentration limits for EP toxicity, which are summarized in Table 3.

TABLE 1

SOIL CONTAMINATION INVESTIGATION

Sample Site	Area Size	Comments
S-1	50'x70'=3,500(2) ft.	Gravel loading dock area located just south of oil room. Area contains visibly oily surface, primarily near dumpsters.
S-2	8'x20'= 160(2) ft.	Small gravel area between Transformer Room and drive which receives wash sink drainage.
S-3	10'x5'= 50(2) ft.	Small sod area between west property boundary and Shipping/Receiving driveway off northwest corner of Butler building.
S-4	20'x10'= 200(2) ft.	Area adjacent to asphalt lot just east of Butler Building.
S-5	10'x10'= 100(2) ft.	Sod area next to fence adjacent to neighboring firm's parking lot, which receives runoff from parking lot.
S-6	(Background Site) Gravel	Gravel area located just off of cement walk ramp near buried fuel tanks.
S-7	(Background Site) Soil	Located in middle of sod field north of Butler building.

TABLE 2

Summary of Analytical Results

Sample Site	TOC	E.P. Toxicity	VOC	Remarks
1	>160,000 ppm	--(1)	720 ppb 110 ppb	1,1-Dichloroethane 1,1,1-Trichloroethane
2	>160,000 ppm	--(1)	--(2)	
3	84,000 ppm	--(1)	--(2)	
4	30,000 ppm	--(1)	--(3)	
5	57,600 ppm	--(1)	--(3)	
6	36,200 ppm	NA	NA	
7	21,800 ppm	NA	NA	

(1) All less than limit for E.P. Toxicity

(2) All less than detection limit of 4 ppb

(3) All less than detection limit of 40 ppb

NA Not Analyzed

TABLE 3

Concentrations of Contaminants
for Characteristics of EP Toxicity

<u>EPA Hazardous Waste Number</u>	<u>Contaminant</u>	<u>Concentration (mg/L)</u>
D004	Arsenic	5.0
D005	Barium	100.0
D006	Cadmium	1.0
D007	Chromium	5.0
D008	Lead	5.0
D009	Mercury	0.2
D010	Selenium	1.0
D011	Silver	5.0

Only sample S-1 contained any detectable quantities of VOC's, as indicated in Table 2.

Even though these appear at very low concentrations, there appears to be no distinction in the RCRA regulations for levels below which a soil or solid waste contaminated with Subpart D "listed" wastes is no longer considered a hazardous material, per 40 CFR 261.3.

The EPA was anonymously contacted to determine if there is any concentration below which a contaminated soil is exempted, and although non-committal, they indicated there is no allowance for exclusions in the regulations. They indicated that the only way for them to make a definite determination, would be at the time they receive a permit request for disposal of the waste, at which time it will be classified as either a hazardous, or a special waste.

Mr. Erich Mueller was questioned to determine any solvents which are purchased, that may contain the contaminants that were found. Two solvents are purchased as follows:

<u>Product</u>	<u>Vendor</u>	<u>Primary Ingredient</u>
New-Tri	Viking Chemical	Trichloroethylene-99%
Safety Solvent	Industrial Oils and Chemicals	1,1,1-Trichloroethane-96.4%

The results of the TOC analyses indicate a definite distinction between the levels found at the background sample locations S-6 and S-7 (average concentration of 29,000 ppm), and sites S-1 and S-2 (concentrations >160,000 ppm). Although S-2 had a high TOC concentration, no VOC's were indicated. Since TOC includes any organic carbon material, it is difficult to determine what may have caused the high reading, the important point being that no VOC's were indicated.

Subsequent to analyzing the sample results, and in light of finding some contamination with VOC's, a search was made for previous soil borings taken at the facility, to determine the nature of subsurface soils. This information was desired in order to determine background data for additional sampling to discover any vertical movement and to determine if any barriers to downward movement existed, as VOC's may be adsorbed and trapped by clay soil particles. Subsequently, foundation borings collected in 1954 were located through STS Consultants. These boring logs indicated a fine to medium sand and gravel to a depth of 27 feet where the water table was encountered.

Based upon this information, it appeared that there is no barrier between the surface and the water table, so that if there was sufficient quantity of contaminants reaching the surface, they may have migrated downward.

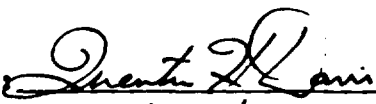
Recommendations

It is recommended that Phase II work be conducted for the site surrounding sample location S-1, to further define the horizontal and any vertical extent of contamination.

The recommended procedure is to collect at the centerpoint and four external corners of the area, at depths of 1, 2.5, 4, 5, 10, 15, 20, and 25 feet, for soils analysis. This will be done with a hollow-stem auger and split-spoon sampling technique. The samples will be analyzed for VOC's. In addition, the center boring will be continued to the water table, for collection and analysis of a water sample.

Following the results of the Phase II work, final recommendations for removal and disposal will be made.

Respectfully submitted,
FEHR, GRAHAM AND ASSOCIATES

BY: 
DATE: 8/24/84

CBC-AquaSearch

ENVIRONMENTAL SERVICES:
Analytical, Field & Consulting
Air
Water & Wastewater
Solid & Hazardous Waste
Industrial Hygiene

F041 8400001

FEHR, GRAHAM AND ASSOCIATES
 660 W STEPHENSON ST
 FREEPORT, IL 61032
 ATTN: QUENTIN H. DAVIS

SAMPLE S-1 SOIL 84202-F01165
 DATE COLLECTED 7/19/84 DATE RECEIVED 7/20/84

BARIUM - EP	0.1	MG/L
CADMIUM - EP	<0.005	MG/L
CHROMIUM - EP	<0.05	MG/L
LEAD - EP	<0.1	MG/L
SILVER - EP	<0.01	MG/L
ARSENIC - EP	<0.001	MG/L
SELENIUM - EP	<0.002	MG/L
MERCURY - EP	<0.0002	MG/L
EP TOXICITY		
TOTAL ORGANIC CARBON	>160000PPM	MG/L
BENZENE	<4PPB	PPB
BROMOFORM	<4PPB	PPB
CARBON TETRACHLORIDE	<4PPB	PPB
CHLOROBENZENE	<4PPB	PPB
CHLORODIBROMOMETHANE	<4PPB	PPB
CHLOROETHANE	<4PPB	PPB
CHLOROETHYL VINYL ETHER	<4PPB	PPB
CHLOROFORM	<4PPB	PPB
DICHLOROBROMOMETHANE	<4PPB	PPB
DICHLORODIFLUOROMETHANE	<4PPB	PPB
1,1-DICHLOROETHANE	720PPB	PPB
1,2-DICHLOROETHANE	<4PPB	PPB
DICHLOROETHYLENE	<4PPB	PPB
DICHLOROPROPANE	<4PPB	PPB
DICHLOROPROPYLENE	<4PPB	PPB
ETHYLBENZENE	<4PPB	PPB
METHYL BROMIDE	<4PPB	PPB
METHYL CHLORIDE	<4PPB	PPB
METHYLENE CHLORIDE	<4PPB	PPB

METHODS FOR CHEMICAL ANALYSIS OF WATER AND WASTES, 1979, EPA-600/4-79-020.
TEST METHODS FOR EVALUATING SOLID WASTE, PHYSICAL/CHEMICAL METHODS,
 1982, EPA 600/4-82-046.
 METHODS 601-612, FEDERAL REGISTER, VOL. 44, NO. 293.

8/1/84 *Steve J. Fraw*
 DATE LABORATORY SUPERVISOR

CBC-AquaSearch**ENVIRONMENTAL SERVICES:***Analytical, Field & Consulting**Air**Water & Wastewater**Solid & Hazardous Waste**Industrial Hygiene*

F041 8400001

FEHR, GRAHAM AND ASSOCIATES
660 W STEPHENSON ST
FREEPORT, IL 61032
ATTN: QUENTIN H. DAVIS

SAMPLE S-1 SOIL 84202-F01165
DATE COLLECTED 7/19/84 DATE RECEIVED 7/20/84

1,1,2,2-TETRACHLOROETHANE	<4PPB	PPB
TATRACHLORAETHYLENE	<4PPB	PPB
TOLUENE	<4PPB	PPB
1,2-TRANSDICHLOROETHYLENE	<4PPB	PPB
1,1,1-TRICHLOROETHENE	110PPB	PPB
1,1,2-TRICHLOROETHANE	<4PPB	PPB
TRICHLOROETHYLENE	<4PPB	PPB
TRICHLOROFLUOROMETHANE	<4PPB	PPB
VINYL CHLORIDE	<4PPB	PPB

SAMPLE S-2 SOIL 84202-F02043
DATE COLLECTED 7/19/84 DATE RECEIVED 7/20/84

BARIUM - EP	0.1	MG/L
CADMIUM - EP	<0.005	MG/L
CHROMIUM - EP	<0.05	MG/L
LEAD - EP	0.1	MG/L
SILVER - EP	<0.01	MG/L
ARESENIC - EP	<0.001	MG/L
SELENIUM - EP	<0.002	MG/L
MERCURY - EP	0.0002	MG/L
EP TOXICITY		
TOTAL ORGANIC CARBON	>160000PPM	MG/L
BENZENE	<4PPB	PPB
BROMOFORM	<4PPB	PPB
CARBON TETRACHLORIDE	<4PPB	PPB
CHLOROBENZENE	<4PPB	PPB
CHLORODIBROMOMETHANE	<4PPB	PPB
CHLOROATHANE	<4PPB	PPB

METHODS FOR CHEMICAL ANALYSIS OF WATER AND WASTES, 1979, EPA-600/4-79-020.

TEST METHODS FOR EVALUATING SOLID WASTE, PHYSICAL/CHEMICAL METHODS,
1982, EPA 600/4-82-010.

METHODS 601-612, FEDERAL REGISTER, VOL. 44, NO. 233.

8/1/84
DATE

Mary N. Linn
LABORATORY SUPERVISOR

CBC-AquaSearch

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Industrial Hygiene

F041 8400001

FEHR, GRAHAM AND ASSOCIATES
660 W STEPHENSON ST
FREEPORT, IL 61032
ATTN: QUENTIN H. DAVIS

SAMPLE S-2 SOIL 84202-F02043
DATE COLLECTED 7/19/84 DATE RECEIVED 7/20/84

CHLOROETHYL VINYL ETHER	<4PPB	PPB
CHLOROFORM	<4PPB	PPB
DICHLOROBROMOMETHANE	<4PPB	PPB
DICHLORODIFLUOROMETHANE	<4PPB	PPB
1,1-DICHLOROETHANE	<4PPB	PPB
1,2-DICHLOROETHANE	<4PPB	PPB
DICHLOROETHYLENE	<4PPB	PPB
DICHLOROPROPANE	<4PPB	PPB
DICHLOROPROPYLENE	<4PPB	PPB
ETHYLBENZENE	<4PPB	PPB
METHYL BROMIDE	<4PPB	PPB
METHYL CHLORIDE	<4PPB	PPB
METHYLENE CHLORIDE	<4PPB	PPB
1,1,2,2-TETRACHLOROETHANE	<4PPB	PPB
TATRACHLORAETHYLENE	<4PPB	PPB
TOLUENE	<4PPB	PPB
1,2-TRANSDICHLOROETHYLENE	<4PPB	PPB
1,1,1-TRICHLOROETHENE	<4PPB	PPB
1,1,2-TRICHLOROETHANE	<4PPB	PPB
TRICHLOROETHYLENE	<4PPB	PPB
TRICHLOROFLUOROMETHANE	<4PPB	PPB
VINYL CHLORIDE	<4PPB	PPB

SAMPLE S-3 SOIL 84202-F02044
DATE COLLECTED 7/19/84 DATE RECEIVED 7/20/84

BARIUM - EP	0.2	MG/L
CADMIUM - EP	<0.005	MG/L
CHROMIUM - EP	<0.05	MG/L

METHODS FOR CHEMICAL ANALYSIS OF WATER AND WASTES, 1979, EPA-600/4-79-020.

TEST METHODS FOR EVALUATING SOLID WASTE, PHYSICAL/CHEMICAL METHODS,

1982, EPA SW846.

METHODS 601-612, FEDERAL REGISTER, VOL. 44, NO. 233.

8/1/84 *Alay J. Lewis*
DATE LABORATORY SUPERVISOR

DIVISION OF CHEM-BIO CORPORATION

140 EAST RYAN ROAD

OAK CREEK WISCONSIN 53154-4599

(414) 784-7005

CBC-AquaSearch

ENVIRONMENTAL SERVICES:
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Solid & Hazardous Waste
Industrial Hygiene

F041 8400001

FEHR, GRAHAM AND ASSOCIATES
 660 W STEPHENSON ST
 FREEPORT, IL 61032
 ATTN: QUENTIN H. DAVIS

SAMPLE S-3 SOIL 84202-F02044
 DATE COLLECTED 7/19/84 DATE RECEIVED 7/20/84

LEAD - EP	<0.1	MG/L
SILVER - EP	<0.01	MG/L
ARSENIC - EP	<0.001	MG/L
SELENIUM - EP	<0.002	MG/L
MERCURY - EP	<0.0002	MG/L
EP TOXICITY		
TOTAL ORGANIC CARBON	84000PPM	MG/L
BENZENE	<4PPB	PPB
BROMOFORM	<4PPB	PPB
CARBON TETRACHLORIDE	<4PPB	PPB
CHLOROBENZENE	<4PPB	PPB
CHLORODIBROMOMETHANE	<4PPB	PPB
CHLOROETHANE	<4PPB	PPB
CHLOROETHYL VINYL ETHER	<4PPB	PPB
CHLOROFORM	<4PPB	PPB
DICHLOROBROMOMETHANE	<4PPB	PPB
DICHLORODIFLUOROMETHANE	<4PPB	PPB
1,1-DICHLOROETHANE	<4PPB	PPB
1,2-DICHLOROETHANE	<4PPB	PPB
DICHLOROETHYLENE	<4PPB	PPB
DICHLOROPROPANE	<4PPB	PPB
DICHLOROPROPYLENE	<4PPB	PPB
ETHYLBENZENE	<4PPB	PPB
METHYL BROMIDE	<4PPB	PPB
METHYL CHLORIDE	<4PPB	PPB
METHYLENE CHLORIDE	<4PPB	PPB
1,1,2,2-TETRACHLOROETHANE	<4PPB	PPB
TETRACHLOROETHYLENE	<4PPB	PPB
TOLUENE	<4PPB	PPB

METHODS FOR CHEMICAL ANALYSIS OF WATER AND WASTES, 1979, EPA-600/4-79-020.

TEST METHODS FOR EVALUATING SOLID WASTE, PHYSICAL/CHEMICAL METHODS,

1982, EPA 600/4-82-010.

METHODS 601-612, FEDERAL REGISTER, VOL. 44, NO. 233.

8/1/84
 DATE

Ray J. Lee
 LABORATORY SUPERVISOR

DIVISION OF CHEM-BIO CORPORATION

140 EAST RYAN ROAD OAK CREEK WISCONSIN 53154-4500

TEL: 264-7005

CBC-AquaSearch

ENVIRONMENTAL SERVICES:
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Solid & Hazardous Waste
Industrial Hygiene

F041 8400001

FEHR, GRAHAM AND ASSOCIATES
 660 W STEPHENSON ST
 FREEPORT, IL 61032
 ATTN: QUENTIN H. DAVIS

SAMPLE S-3 SOIL 84202-F02044
 DATE COLLECTED 7/19/84 DATE RECEIVED 7/20/84

1,2-TRANSDICHLOROETHYLENE	<4PPB	PPB
1,1,1-TRICHLOROETHENE	<4PPB	PPB
1,1,2-TRICHLOROETHANE	<4PPB	PPB
TRICHLOROETHYLENE	<4PPB	PPB
TRICHLOROFLUOROMETHANE	<4PPB	PPB
VINYL CHLORIDE	<4PPB	PPB

SAMPLE S-4 SOIL 84202-F02045
 DATE COLLECTED 7/19/84 DATE RECEIVED 7/20/84

BARIUM - EP	0.1	MG/L
CADMIUM - EP	<0.005	MG/L
CHROMIUM - EP	<0.05	MG/L
LEAD - EP	<0.1	MG/L
SILVER - EP	<0.01	MG/L
ARSENIC - EP	0.010	MG/L
SELENIUM - EP	0.002	MG/L
MERCURY - EP	0.0003	MG/L
EP TOXICITY		
TOTAL ORGANIC CARBON	30000PPM	MG/L
BENZENE	<40PPB	PPB
BROMOFORM	<40PPB	PPB
CARBON TETRACHLORIDE	<40PPB	PPB
CHLOROBENZENE	<40PPB	PPB
CHLORODIBROMOMETHANE	<40PPB	PPB
CHLOROETHANE	<40PPB	PPB
CHLOROETHYL VINYL ETHER	<40PPB	PPB
CHLOROFORM	<40PPB	PPB
DICHLOROBROMOMETHANE	<40PPB	PPB

METHODS FOR CHEMICAL ANALYSIS OF WATER AND WASTES, 1979, EPA-600/4-79-020.

TEST METHODS FOR EVALUATING SOLID WASTE, PHYSICAL/CHEMICAL METHODS,

1982, EPA 600/4-82-010.

METHODS 601-612, FEDERAL REGISTER, VOL. 44, NO. 233.

Q. H. Davis
 DATE

Quentin H. Davis
 LABORATORY SUPERVISOR

DIVISION OF CHEM-BIO CORPORATION

140 EAST RYAN ROAD OAK CREEK WISCONSIN 53154-4500 (414) 764-7005

CBC-AquaSearch

ENVIRONMENTAL SERVICES:
Analytical, Field & Consulting
Air
Water & Wastewater
Solid & Hazardous Waste
Industrial Hygiene

F041 8400001

FEHR, GRAHAM AND ASSOCIATES
 660 W STEPHENSON ST
 FREEPORT, IL 61032
 ATTN: QUENTIN H. DAVIS

SAMPLE S-4 SOIL 84202-F02045
 DATE COLLECTED 7/19/84 DATE RECEIVED 7/20/84

DICHLORODIFLUOROMETHANE	<40PPB	PPB
1,1-DICHLOROETHANE	<40PPB	PPB
1,2-DICHLOROETHANE	<40PPB	PPB
DICHLOROETHYLENE	<40PPB	PPB
DICHLOROPROPANE	<40PPB	PPB
DICHLOROPROPYLENE	<40PPB	PPB
ETHYLBENZENE	<40PPB	PPB
METHYL BROMIDE	<40PPB	PPB
METHYL CHLORIDE	<40PPB	PPB
METHYLENE CHLORIDE	<40PPB	PPB
1,1,2,2-TETRACHLOROETHANE	<40PPB	PPB
TETRACHLOROETHYLENE	<40PPB	PPB
TOLUENE	<40PPB	PPB
1,2-TRANSDICHLOROETHYLENE	<40PPB	PPB
1,1,1-TRICHLOROETHENE	<40PPB	PPB
1,1,2-TRICHLOROETHANE	<40PPB	PPB
TRICHLOROETHYLENE	<40PPB	PPB
TRICHLOROFLUOROMETHANE	<40PPB	PPB
VINYL CHLORIDE	<40PPB	PPB

SAMPLE S-5 SOIL 84202-F02194
 DATE COLLECTED 7/19/84 DATE RECEIVED 7/20/84

BARIUM - EP	0.1	MG/L
CADMIUM - EP	<0.005	MG/L
CHROMIUM - EP	<0.05	MG/L
LEAD - EP	<0.1	MG/L
SILVER - EP	<0.01	MG/L
ARSENIC - EP	<0.001	MG/L

METHODS FOR CHEMICAL ANALYSIS OF WATER AND WASTES, 1979, EPA-600/4-79-020.

TEST METHODS FOR EVALUATING SOLID WASTE, PHYSICAL/CHEMICAL METHODS,

1982, EPA SW846.

METHODS 601-612, FEDERAL REGISTER, VOL. 44, NO. 233.

8/1/84 *Harry J. Linn*
 DATE LABORATORY SUPERVISOR

DIVISION OF CHEM-BIO CORPORATION

140 EAST RYAN ROAD OAK CREEK, WISCONSIN 53154-4599 (414) 764-7005

CBC-AquaSearch

ENVIRONMENTAL SERVICES:
Analytical, Field & Consulting
Air
Water & Wastewater
Solid & Hazardous Waste
Industrial Hygiene

F041 3400001

FEHR, GRAHAM AND ASSOCIATES
660 W STEPHENSON ST
FREEPORT, IL 61032
ATTN: QUENTIN H. DAVIS

SAMPLE S-5 SOIL 84202-F02194
DATE COLLECTED 7/19/84 DATE RECEIVED 7/20/84

SELENIUM - EP	<0.002	MG/L
MERCURY - EP	<0.0002	MG/L
EP TOXICITY		
TOTAL ORGANIC CARBON	57600PPM	MG/L
BENZENE	<40PPB	PPB
BROMOFORM	<40PPB	PPB
CARBON TETRACHLORIDE	<40PPB	PPB
CHLOROBENZENE	<40PPB	PPB
CHLORODIBROMOMETHANE	<40PPB	PPB
CHLOROETHANE	<40PPB	PPB
CHLOROETHYL VINYL ETHER	<40PPB	PPB
CHLOROFORM	<40PPB	PPB
DICHLOROBROMOMETHANE	<40PPB	PPB
DICHLORODIFLUOROMETHANE	<40PPB	PPB
1,1-DICHLOROETHANE	<40PPB	PPB
1,2-DICHLOROETHANE	<40PPB	PPB
DICHLOROETHYLENE	<40PPB	PPB
DICHLOROPROPANE	<40PPB	PPB
DICHLOROPROPYLENE	<40PPB	PPB
ETHYLBENZENE	<40PPB	PPB
METHYL BROMIDE	<40PPB	PPB
METHYL CHLORIDE	<40PPB	PPB
METHYLENE CHLORIDE	<40PPB	PPB
1,1,2,2-TETRACHLOROETHANE	<40PPB	PPB
TETRACHLOROETHYLENE	<40PPB	PPB
TOLUENE	<40PPB	PPB
1,2-TRANSDICHLOROETHYLENE	<40PPB	PPB
1,1,1-TRICHLOROETHENE	<40PPB	PPB
1,1,2-TRICHLOROETHANE	<40PPB	PPB

METHODS FOR CHEMICAL ANALYSIS OF WATER AND WASTES, 1979, EPA-600/4-79-020.

TEST METHODS FOR EVALUATING SOLID WASTE, PHYSICAL/CHEMICAL METHODS,

1982, EPA 600/4-82-010.

METHODS 601-612, FEDERAL REGISTER, VOL. 44, NO. 233.

8/1/84
DATE

LABORATORY

PREPARED BY

CBC-AquaSearch**ENVIRONMENTAL SERVICES:***Analytical, Field & Consulting**Air**Water & Wastewater**Solid & Hazardous Waste**Industrial Hygiene*

F041 8400001

FEHR, GRAHAM AND ASSOCIATES
660 W STEPHENSON ST
FREEPORT, IL 61032
ATTN: QUENTIN H. DAVIS

SAMPLE S-5 SOIL 84202-F02194
DATE COLLECTED 7/19/84 DATE RECEIVED 7/20/84

TRICHLOROETHYLENE	40PPB	PPB
TRICHLOROFLUOROMETHANE	40PPB	PPB
VINYL CHLORIDE	40PPB	PPB

METHODS 601-612, FEDERAL REGISTER, VOL. 44, NO. 105.

8/1/84
DATE

Way N. Lee
ANALYST

DIVISION OF CHEM-BIO CORPORATION

140 EAST RYAN ROAD OAK CREEK WISCONSIN 53154-1494

TEL: 414/221-1100

7/27/84

LABORATORY REPORT

PAGE 1

CBC-AquaSearch

ENVIRONMENTAL SERVICES:
Analytical, Field & Consulting
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Water & Wastewater
Solid & Hazardous Waste
Industrial Hygiene

FEHR, GRAHAM AND ASSOCIATES
660 W STEPHENSON ST
FREEPORT, IL 61032
ATTN: QUENTIN H. DAVIS

SAMPLE	S-6 SOIL	84202-F02195		
DATE COLLECTED	7/19/84	DATE RECEIVED	7/20/84	
	TOTAL ORGANIC CARBON	36200PPM		MG/L

SAMPLE	S-7 SOIL	84202-F02264		
DATE COLLECTED	7/19/84	DATE RECEIVED	7/20/84	
	TOTAL ORGANIC CARBON	21800PPM		MG/L

METHODS FOR CHEMICAL ANALYSIS OF WATER AND WASTES, 1979, EPA-600/4-79-020.

7/27/84 Steve J. Loran
DATE LABORATORY SUPERVISOR

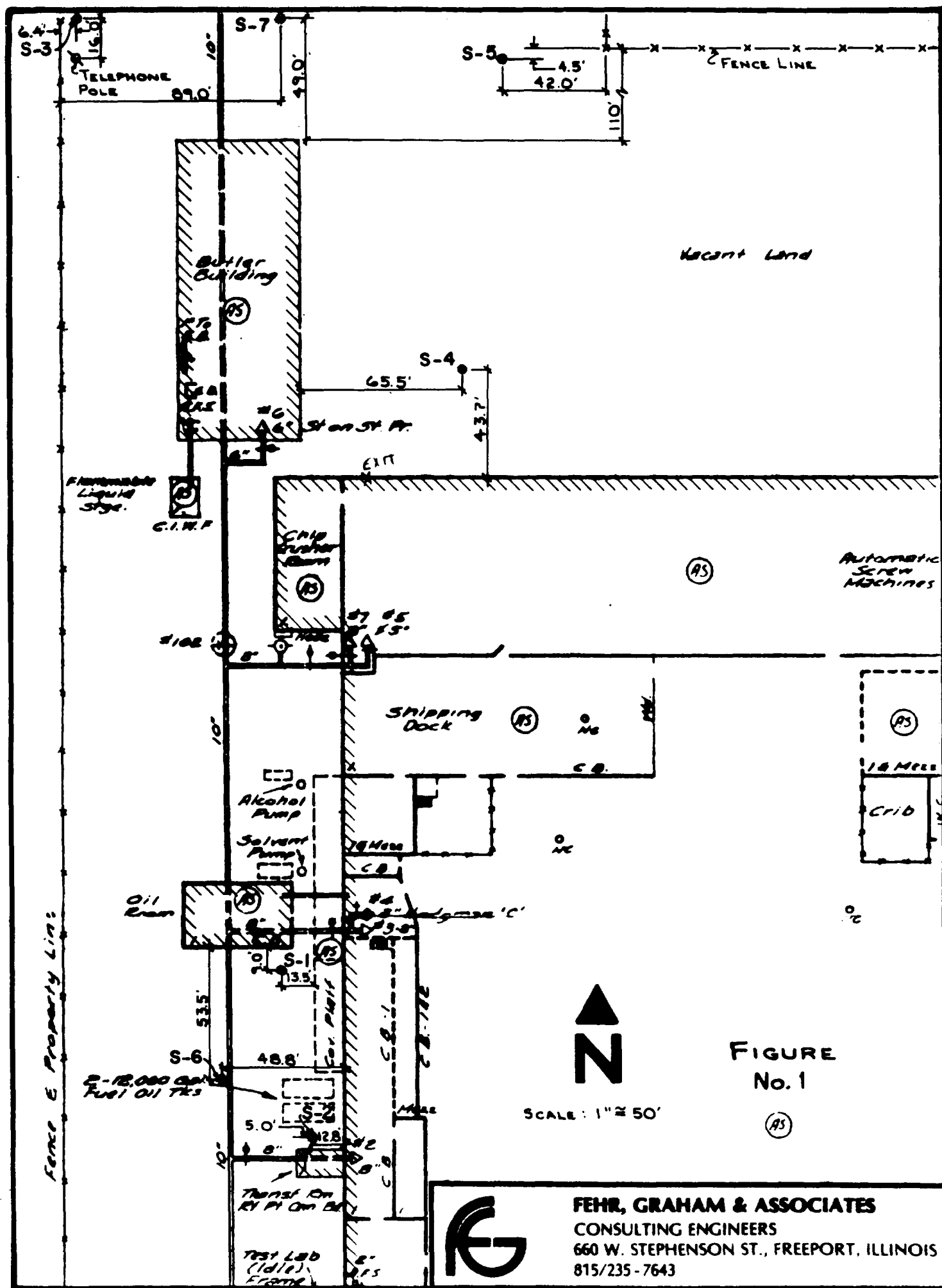


FIGURE
No. 1



FEHR, GRAHAM & ASSOCIATES
 CONSULTING ENGINEERS
 660 W. STEPHENSON ST., FREEPORT, ILLINOIS
 815/235-7643

GROUND WATER INVESTIGATION

SUNTEC INDUSTRIES, INC.

JANUARY 23, 1990

PREPARED BY:

**ENVIROMENTAL RESOURCES MANAGEMENT-NORTH CENTRAL, INC.
102 WILMOT ROAD, SUITE 300
DEERFIELD, IL 60015**

PROJECT NO. 9239

GROUND WATER INVESTIGATION

SUNTEC INDUSTRIES, INC.

1.0 INTRODUCTION

The Suntec Industries, Inc. (Suntec) facility, located at 2210 Harrison Avenue, Rockford, Illinois, used 14 underground storage tanks and two in-ground, vaulted storage tanks. Two underground tanks at the facility are currently used to store space heating oil. These last two tanks were installed in 1977 to replace two older underground tanks taken out of service at that time. Suntec began a program to close all of the facility's underground storage tanks, except the two, newer fuel oil tanks, in January 1989. Subsequently, Suntec made the decision to include the fuel oil tanks in the closure program. Initial steps in the tank closure program involved the removal of tank contents, tank cleaning, and sampling and analysis of soils in the immediate vicinity. The results of the soil analyses indicated that soils in the vicinity of several tanks contained volatile and semivolatile organic compounds. Based on the analytical data, Suntec notified the Illinois Environmental Protection Agency (IEPA) on February 9, 1989 of a potential release from these underground tanks.

At the request of Suntec, Environmental Resources Management-North Central, Inc. (ERM) performed a Phase I Investigation to determine the degree and extent of organic compounds in the vicinity of these tanks. A report presenting data obtained during this initial investigation was submitted to the IEPA on May 1, 1989. As indicated in the Phase I report, three areas containing volatile compounds were identified in the northern portion of the underground tank area. The May report also contained a work plan for a Phase II Investigation designed to obtain further information concerning the horizontal and vertical extent of volatile compounds within the identified areas. A report presenting the data obtained as a result of this Phase II Investigation was submitted to IEPA on October 3, 1989.

The Phase II Investigation included the installation, development and sampling of a ground water monitoring well in an area identified as containing concentrations of volatile organic compounds during the Phase I Investigation. A sample of ground water obtained from this monitoring well was submitted for laboratory analyses of volatile compounds and isopropyl alcohol. The analytical results indicated that chlorinated solvents, primarily trichloroethene (TCE) and its related breakdown products were present in the ground water sample. No additional ground water sampling from new or existing monitoring wells located on the Suntec property was performed as part of the Phase II Investigation. The October report outlined and recommended an investigation designed to develop data concerning the quality and flow direction of ground water at the site. The objectives of this ground water investigation were:

- o To secure information concerning local ground water flow direction and gradient;

- o To obtain information necessary to assess the degree of impact, if any, that the presence of volatile compounds in soils in the areas previously identified have had on ground water quality; and
- o To identify additional actions that might be required to further assess and control any impact on local ground water quality.

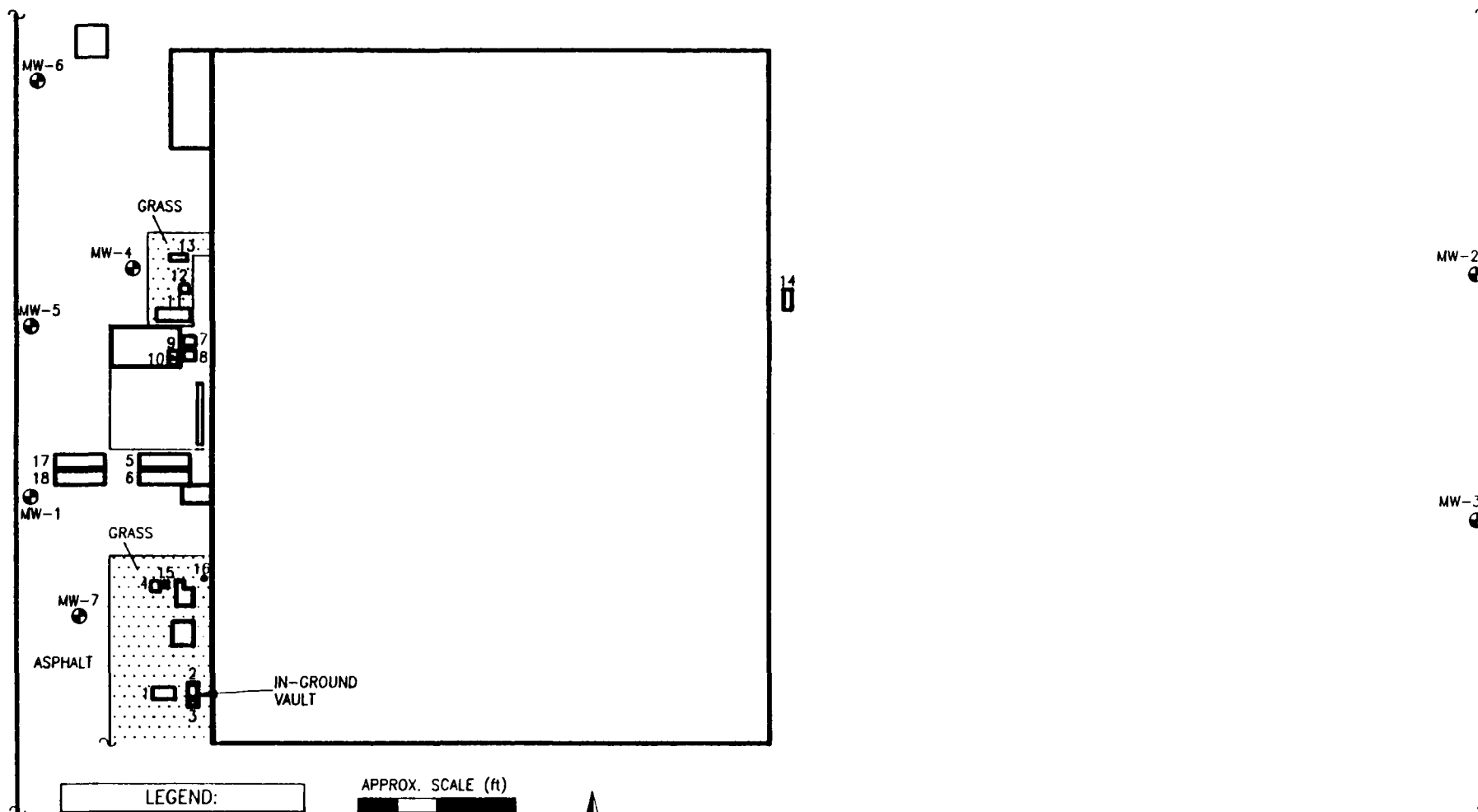
These objectives were met through the performance of a ground water sampling program that included: (1) sampling the four existing monitoring wells at the Suntec facility, and (2) the installation and sampling of three new on-site monitoring wells.

The following sections of this report describe the Ground Water Investigation methodology and present all investigation data, conclusions, and recommendations.

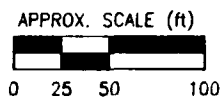
2.0 PROGRAM METHODOLOGY

2.1 New Monitoring Well Locations

The three new Monitoring Wells (MW-5, MW-6, and MW-7) were installed in the locations shown in Figure 1. These locations were selected by ERM to permit the sampling of ground water downgradient of the areas previously identified as containing volatile compounds. Well construction logs, prepared by an ERM geologist for these new wells, are presented in Appendix A.



LEGEND:	
	BUILDING LINE
	PROPERTY LINE
	CONCRETE EDGE
	UNDERGROUND TANK NO. & LOCATION
	MW-3 MONITORING WELL LOCATION



SUNTEC INDUSTRIES, INC. MONITORING WELL LOCATIONS	FIGURE 1
	12/7/89
	9/7/89

ST1001

ERM ERM-North Central, Inc.

2.2 Monitoring Well Development

Following installation, the new monitoring wells were developed on November 10, 1989 by removing a volume of ground water equal to or greater than five times the wet casing volume until the water quality parameters pH, temperature and conductivity stabilized. Dedicated Teflon bailers were used in well development and, subsequently, to collect well samples. The well development waters were collected and discharged to a sanitary sewer connection at the Suntec facility.

2.3 Establishment of Vertical and Horizontal Control

All seven monitoring wells located on the Suntec property were "surveyed-in" to establish their vertical and horizontal position relative to each other and a permanent benchmark located near the Suntec facility. The establishment of vertical and horizontal control and the measurement of monitoring well water levels permitted the determination of the local ground water flow direction and gradient.

2.4 Ground Water Sampling

Ground water samples were obtained from the seven monitoring wells by ERM on November 13, 1989. The monitoring wells were purged prior to sampling by the removal of a volume of ground water equal to or greater than five times the wet casing volume to insure that a sample representative of the surrounding ground water would be obtained. Ground water samples were submitted to Radian Corporation for analysis of volatile and semivolatile organic compounds.

3.0 DISCUSSION OF PROGRAM DATA

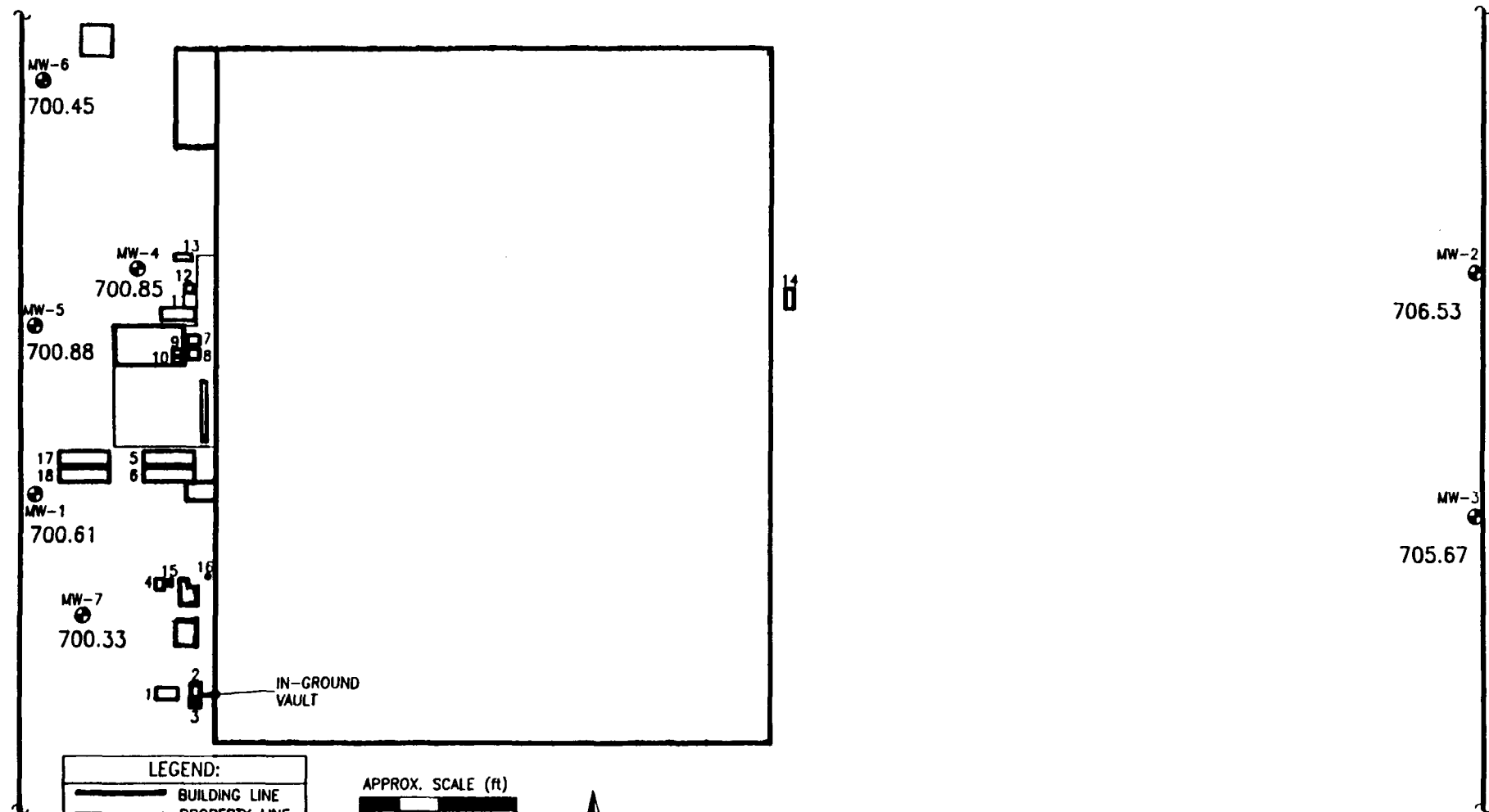
3.1 Ground Water Flow Direction

Monitoring well water level measurements taken prior to sampling (November 13, 1989) were used in conjunction with the well location survey data to calculate water table elevations at each sampling location. These elevations, expressed as Mean Sea Level, are shown in Figure 2. Based on the water table elevation data, the local ground water flow at the Suntec facility is in a westerly direction. The data is anomalous as to whether there is a north-south component. The small water table elevation gradient, approximately 0.75 feet per 100 feet, across the Suntec property indicated by this data is most likely a result of the influence of the nearby Rock River on water levels in the uppermost aquifer.

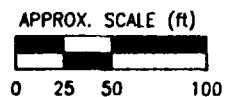
3.2 Ground Water Analytical Data

Ground water samples obtained by ERM from seven monitoring wells on November 13, 1989 were submitted for laboratory analysis of volatile and semivolatile compounds. The analytical data obtained from these samples are summarized in Table 1. The complete analytical laboratory report is included in Appendix B. Table 1 presents concentrations for only those compounds present above the detection and qualification limits.

Based on the direction of ground water flow determined during the course of this investigation, Monitoring Wells MW-2 and MW-3 were identified as upgradient wells. No measurable volatile compounds were present in ground water samples taken from these wells.



LEGEND:	
	BUILDING LINE
	PROPERTY LINE
	CONCRETE EDGE
	UNDERGROUND TANK NO. & LOCATION
	MONITORING WELL LOCATION
705.67	ELEVATION (FT.)



SUNTEC INDUSTRIES, INC. MONITORING WELL WATER LEVELS	
FIGURE 2	
ERM North Central, Inc.	12/7/89

TABLE 1
GROUND WATER ANALYTICAL DATA
November 13, 1989

<u>Parameter</u>	<u>Monitoring Wells</u>						
	<u>MW-1</u>	<u>MW-2</u>	<u>MW-3</u>	<u>MW-4</u>	<u>MW-5</u>	<u>MW-6</u>	<u>MW-7</u>
1,1-Dichloroethane	120	BDL	BDL	170	130	BDL	BDL
Ethyl Benzene	BDL	BDL	BDL	BDL	BDL	140	BDL
Tetrachloroethene	32	BDL	BDL	110	35	BQL	BDL
1,1,1-Trichloroethane	260	BDL	BQL	420	280	BQL	BQL
Trichloroethene	28	BDL	BDL	190	110	BDL	BDL

All units are ug/l.
BDL - Below detection limit.
BQL - Below quantification limit.

The presence of the four volatile compounds 1,1-dichloroethane, 1,1,1-trichloroethane, trichloroethene, and tetrachloroethene in Monitoring Well MW-4 and Monitoring Wells MW-1 and MW-5 (in lower concentrations) is consistent with soil analysis data obtained during the Phase I and II Investigations. As indicated in the Phase I and II Investigation reports, soils in the Scrap Metal Storage Area and in the vicinity of Tank Nos. 11, 12 and 13 contain volatile organic compounds. Because ground water samples taken from monitoring wells at the east end of the property, upgradient of these areas, do not contain measurable quantities of these four compounds, the most likely source of these volatile compounds are the soils on the property. And because these compounds have been identified in the soils around the Scrap Metal Storage Area and in the vicinity of Tank Nos. 11, 12, and 13, these areas are the probable sources. Remediation of this source area has been addressed in the accompanying Soil Remediation Work Plan.

As stated previously, no ground water samples were obtained from off-site sampling locations during this investigation.

As noted in Table 1, ethyl benzene was found only in the ground water taken from MW-6, away from Tank No. 4, the only tank identified as storing gasoline. Accordingly, the presence of ethyl benzene in ground water taken from MW-6 did not result from a release from an underground storage tank. The absence of measurable components of gasoline (BETX compounds) in the ground water sample taken from Monitoring Well MW-7 supports the conclusion that any release of product from Tank No. 4 has not affected the quality of ground water in the uppermost aquifer.

Furthermore, interviews with facility employees indicated that chlorinated solvents were not stored in the tanks in the vicinity of Monitoring Wells MW-1, MW-4, and MW-5. Consequently, it does not appear that the presence of these compounds resulted from a leak from an underground storage tank.

The consideration of what additional investigative efforts are necessary to evaluate the impact on local ground water quality, is now being made by Suntec. Based on the information obtained in this investigation, Suntec will propose any additional investigative efforts determined to be appropriate in a Work Plan submitted to IEPA by February 28, 1990.

APPENDIX A

WELL CONSTRUCTION LOG



* DEPTH BELOW LAND SURFACE

PROJECT Sunstar Industries WELL MW-4
TOWN/CITY Rockford
COUNTY Winnebago STATE IL
PERMIT NO. 5/4
LAND-SURFACE ELEVATION _____
AND DATUM _____ feet ☐ SURVEYED
_____ ☐ ESTIMATED
INSTALLATION DATE(S) 11-3-89
DRILLING METHOD 3 3/4" ID HS-Angel
DRILLING CONTRACTOR Fix Drilling, Inc.
DRILLING FLUID NONE

DEVELOPMENT TECHNIQUE(S) AND DATE(S)

FLUID LOSS DURING DRILLING 4.5 GAL
WATER REMOVED DURING DEVELOPMENT

STATIC DEPTH TO WATER
38.46' FEET BELOW M.P.

PUMPING DEPTH TO WATER
N/A FEET BELOW M.P.

PUMPING DURATION 4.5 HOURS

YIELD N/A gpm DATE N/A

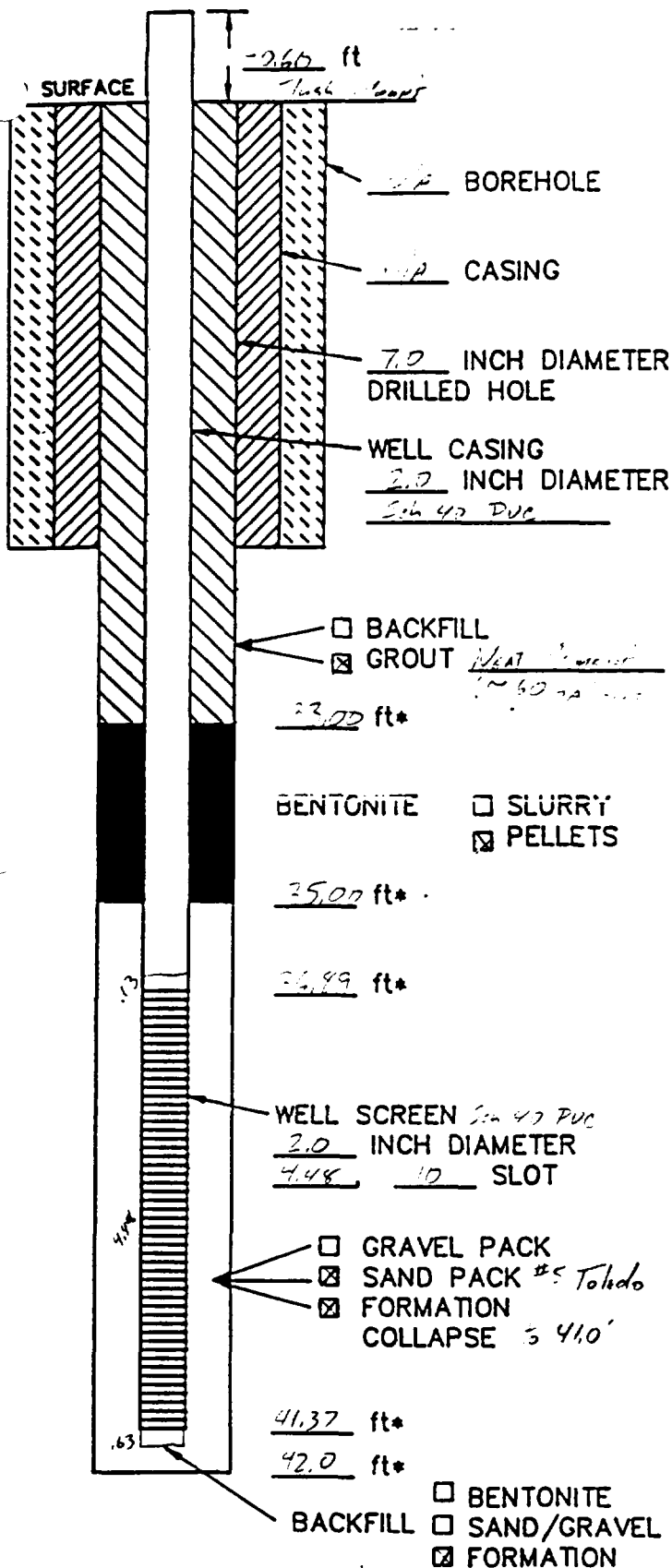
SPECIFIC CAPACITY 1.4 gpm/ft

WELL PURPOSE WATER TABLE MONITORING
WELL

REMARKS

PREPARED BY D P Edwards

WELL CONSTRUCTION LOG



MEASURING POINT IS TOP OF WELL CASING UNLESS OTHERWISE NOTED.

* DEPTH BELOW LAND SURFACE

PROJECT Santec Industries WELL #WS
 TOWN/CITY Rockford
 COUNTY Winnebago STATE IL
 PERMIT NO. N/A
 LAND-SURFACE ELEVATION _____
 AND DATUM _____ feet ☐ SURVEYED ☐ ESTIMATED
 INSTALLATION DATE(S) 11-7-89
 DRILLING METHOD 3 3/4" ID HS-Auger
 DRILLING CONTRACTOR For Dilling, Inc.
 DRILLING FLUID NONE

DEVELOPMENT TECHNIQUE(S) AND DATE(S)

FLUID LOSS DURING DRILLING N/A GAL
 WATER REMOVED DURING DEVELOPMENT _____ GAL

STATIC DEPTH TO WATER
37.82' FEET BELOW M.P.

PUMPING DEPTH TO WATER
N/A FEET BELOW M.P.

PUMPING DURATION N/A HOURS

YIELD N/A gpm DATE N/A

SPECIFIC CAPACITY N/A gpm/ft

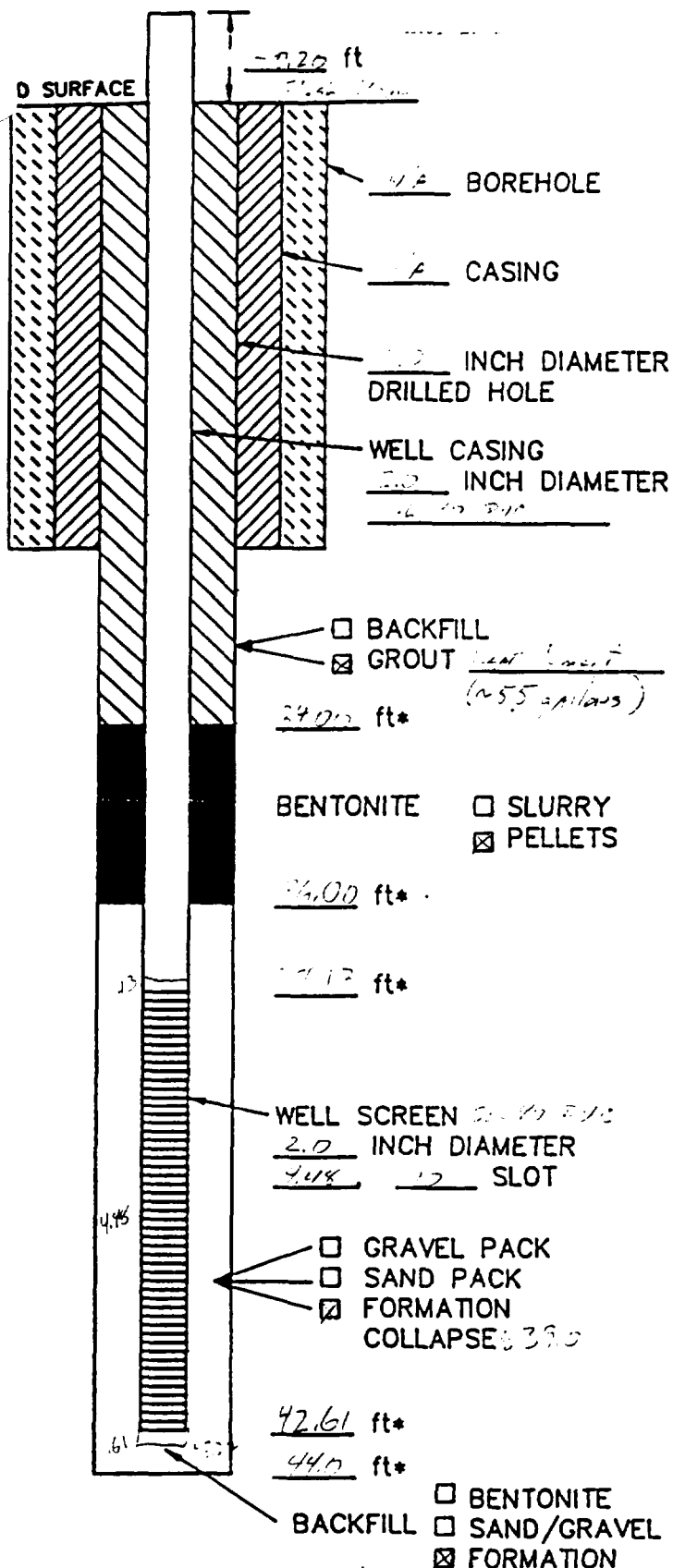
WELL PURPOSE Water table monitoring well

REMARKS First attempt to install MDS resulted in the well screen becoming bent and the casing was damaged. Well was not installed. Second well was installed in E' of last boring.

PREPARED BY D.P. Edwards

TD = 42.35' BGS

WELL CONSTRUCTION LOG



MEASURING POINT IS TOP OF WELL CASING UNLESS OTHERWISE NOTED.

* DEPTH BELOW LAND SURFACE

PROJECT Water Supply WELL W-6
 TOWN/CITY ...
 COUNTY ... STATE IL
 PERMIT NO. ...
 LAND-SURFACE ELEVATION
 AND DATUM ... feet ☐ SURVEYED
☐ ESTIMATE
 INSTALLATION DATE(S) 1-7-89
 DRILLING METHOD ...
 DRILLING CONTRACTOR ...
 DRILLING FLUID ...

DEVELOPMENT TECHNIQUE(S) AND DATE(S)

FLUID LOSS DURING DRILLING ... GA
 WATER REMOVED DURING DEVELOPMENT

STATIC DEPTH TO WATER
39.62 FEET BELOW M.F.

PUMPING DEPTH TO WATER
... FEET BELOW M.F.

PUMPING DURATION ... HOURS
 YIELD ... gpm DATE ...

SPECIFIC CAPACITY ... gpm/ft
 WELL PURPOSE Water Supply

REMARKS

PREPARED BY D.P. Edwards

APPENDIX B

ERM - North Central
Radian Work Order: 89-11-134

Method:SW8240-Illinois list (1)

List:SW8240-Illinois list

Sample ID:	MW-1	MW-2	MW-3	MW-4	MW-7	MW-7 BK
Factor:	1	1	1	1	1	1
Results in:	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
	01A	02A	03A	04A	05A	06A
Matrix:	water	water	water	water	water	water

Acetone	<100	<100	<100	<100	<100	<100
Acrolein	<75	<75	<75	<75	<75	<75
Acrylonitrile	<25	<25	<25	<25	<25	<25
Benzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Bromodichloromethane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Bromomethane	<10	<10	<10	<10	<10	<10
Carbon disulfide	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Carbon tetrachloride	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Chlorobenzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Chloroethane	<10	<10	<10	<10	<10	<10
2-Chloroethyl vinyl ether	<10	<10	<10	<10	<10	<10
Chloroform	<5.0	<5.0	<5.0	<u>7.3 *</u>	<5.0	<5.0
Chloromethane	<10	<10	<10	<10	<10	<10
Dibromochloromethane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Dibromomethane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
trans-1,4-Dichloro-2-butene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Dichlorodifluoromethane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1-Dichloroethane	<u>120</u>	<5.0	<5.0	<u>170</u>	<u>130</u>	<5.0
1,2-Dichloroethane	<5.0	<5.0	<5.0	<5.0	<u>10 *</u>	<5.0
1,1-Dichloroethene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
trans-1,2-Dichloroethene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,2-Dichloropropane	<5.0	<5.0	<5.0	<u>14 *</u>	<u>11 *</u>	<5.0
cis-1,3-Dichloropropene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
trans-1,3-Dichloropropene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Ethyl benzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Ethyl methacrylate	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
n-Hexane	<10	<10	<10	<10	<10	<10
2-Hexanone	<50	<50	<50	<50	<50	<50
Iodomethane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Methyl ethyl ketone	<100	<100	<100	<100	<100	<100

* Est. result less than 5 times detection limit

(1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.

ERM - North Central
 Radian Work Order: 89-11-134

Method:SW8240-Illinois list (1)

List:SW8240-Illinois list

Sample ID:	MW-1	MW-2	MW-3	MW-4	MW-7	MW-7 BK
Factor:	1	1	1	1	1	1
Results in:	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
	01A	02A	03A	04A	05A	06A
Matrix:	water	water	water	water	water	water

Methyl methacrylate	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
4-Methyl-2-pentanone(MIBK)	<50	<50	<50	<50	<50	<50
Methylene chloride	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Styrene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1,2,2-Tetrachloroethane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Tetrachloroethene	<u>32</u>	<5.0	<5.0	<u>110</u>	<u>35</u>	<5.0
Toluene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Tribromomethane(Bromoform)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1,1-Trichloroethane	<u>260</u>	<5.0	<u>5.5 *</u>	<u>420</u>	<u>280</u>	<5.0
1,1,2-Trichloroethane	<5.0	<5.0	<5.0	<5.0	<u>6.5 *</u>	<5.0
Trichloroethene	<u>28</u>	<5.0	<5.0	<u>190</u>	<u>110</u>	<5.0
Trichlorofluoromethane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,2,3-Trichloropropane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Vinyl acetate	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Vinyl chloride	<10	<10	<10	<10	<10	<10
Xylenes	<15	<15	<15	<15	<15	<15
<u>Surrogate Recovery(%)</u>						
1,4-Bromofluorobenzene	84	82	89	96	91	94
Control Limits: 55 to 167						
1,2-Dichloroethane-d4	110	108	110	100	104	102
Control Limits: 39 to 156						
Toluene-d8	91	96	97	97	97	98
Control Limits: 58 to 146						

* Est. result less than 5 times detection limit

(1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.

ERM - North Central
Radian Work Order: 89-11-134

Method:SW8240-Illinois list (1)

List:SW8240-Illinois list

Sample ID:	MW-8	MW-9	TRIP BLANK #1	TRIP BLANK #2	SYSTEM BLANK
Factor:	1	1	1	1	1
Results in:	ug/L	ug/L	ug/L	ug/L	ug/L
	07A	08A	09A	10A	12A
Matrix:	water	water	water	water	water

Acetone	<100	<100	<100	<100	<100
Acrolein	<75	<75	<75	<75	<75
Acrylonitrile	<25	<25	<25	<25	<25
Benzene	<5.0	<5.0	<5.0	<5.0	<5.0
Bromodichloromethane	<5.0	<5.0	<5.0	<5.0	<5.0
Bromomethane	<10	<10	<10	<10	<10
Carbon disulfide	<5.0	<5.0	<5.0	<5.0	<5.0
Carbon tetrachloride	<5.0	<5.0	<5.0	<5.0	<5.0
Chlorobenzene	<5.0	<5.0	<5.0	<5.0	<5.0
Chloroethane	<10	<10	<10	<10	<10
2-Chloroethyl vinyl ether	<10	<10	<10	<10	<10
Chloroform	<5.0	<5.0	<5.0	<5.0	<5.0
Chloromethane	<10	<10	<10	<10	<10
Dibromochloromethane	<5.0	<5.0	<5.0	<5.0	<5.0
Dibromomethane	<5.0	<5.0	<5.0	<5.0	<5.0
trans-1,4-Dichloro-2-butene	<5.0	<5.0	<5.0	<5.0	<5.0
Dichlorodifluoromethane	<5.0	<5.0	<5.0	<5.0	<5.0
1,1-Dichloroethane	<5.0	<5.0	<5.0	<5.0	<5.0
1,2-Dichloroethane	<5.0	<5.0	<5.0	<5.0	<5.0
1,1-Dichloroethene	<5.0	<5.0	<5.0	<5.0	<5.0
trans-1,2-Dichloroethene	<5.0	<5.0	<5.0	<5.0	<5.0
1,2-Dichloropropane	<5.0	<5.0	<5.0	<5.0	<5.0
cis-1,3-Dichloropropene	<5.0	<5.0	<5.0	<5.0	<5.0
trans-1,3-Dichloropropene	<5.0	<5.0	<5.0	<5.0	<5.0
Ethyl benzene	140	<5.0	<5.0	<5.0	<5.0
Ethyl methacrylate	<5.0	<5.0	<5.0	<5.0	<5.0
n-Hexane	<10	<10	<10	<10	<10
2-Hexanone	<50	<50	<50	<50	<50
Iodomethane	<5.0	<5.0	<5.0	<5.0	<5.0
Methyl ethyl ketone	<100	<100	<100	<100	<100

(1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.

ERM - North Central
 Radian Work Order: 89-11-134

Method: SW8240-Illinois list (1)

List: SW8240-Illinois list

Sample ID:	MW-8	MW-9	TRIP BLANK #1	TRIP BLANK #2	SYSTEM BLANK
Factor:	1	1	1	1	1
Results in:	ug/L	ug/L	ug/L	ug/L	ug/L
	07A	08A	09A	10A	12A
Matrix:	water	water	water	water	water

Methyl methacrylate	<5.0	<5.0	<5.0	<5.0	<5.0
4-Methyl-2-pentanone(MIBK)	<50	<50	<50	<50	<50
Methylene chloride	<5.0	<5.0	<5.0	<u>23 *</u>	<5.0
Styrene	<5.0	<5.0	<5.0	<5.0	<5.0
1,1,2,2-Tetrachloroethane	<5.0	<5.0	<5.0	<5.0	<5.0
Tetrachloroethene	<u>8.5 *</u>	<5.0	<5.0	<5.0	<5.0
Toluene	<5.0	<5.0	<5.0	<5.0	<5.0
Tribromomethane(Bromoform)	<5.0	<5.0	<5.0	<5.0	<5.0
1,1,1-Trichloroethane	<u>13 *</u>	<u>13 *</u>	<5.0	<5.0	<5.0
1,1,2-Trichloroethane	<5.0	<5.0	<5.0	<5.0	<5.0
Trichloroethene	<5.0	<5.0	<5.0	<5.0	<5.0
Trichlorofluoromethane	<5.0	<5.0	<5.0	<5.0	<5.0
1,2,3-Trichloropropane	<5.0	<5.0	<5.0	<5.0	<5.0
Vinyl acetate	<5.0	<5.0	<5.0	<5.0	<5.0
Vinyl chloride	<10	<10	<10	<10	<10
Xylenes	<u>24 *</u>	<15	<15	<15	<15

Surrogate Recovery(%)

1,4-Bromofluorobenzene	89	94	92	83	97
Control Limits: 55 to 167					
1,2-Dichloroethane-d4	101	108	105	108	115
Control Limits: 39 to 156					
Toluene-d8	96	100	103	92	103
Control Limits: 58 to 146					

* Est. result less than 5 times detection limit

(1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.



Radian Work Order 89-11-134

Analytical Report
12/05/89

ERM - North Central

ERM North Central
102 Wilmont Road
Deerfield, IL 60015

Dave Edwards

Customer Work Identification Suntech
Purchase Order Number 9239JK01

Contents:

- 1 Analytical Data Summary
- 2 Sample History
- 3 Comments Summary
- 4 Notes and Definitions

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Client Services Coordinator: SKMERTENS

Certified by:

Michael C. Sheple

ERM - North Central
Radian Work Order: 89-11-134

Method:SW8270-Illinois list (1)

List:SW8270-Illinois list

Sample ID:	MW-1	MW-2	MW-3	MW-4	MW-7	MW-7 BK
Factor:	1	1	1	2	1	1
Results in:	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
	01D	02D	03D	04D	05D	06D
Matrix:	water	water	water	water	water	water

Acenaphthene	<1200	<1200	<1200	<2400	<1200	<1200
Acenaphthylene	<660	<660	<660	<1300	<660	<660
Acetophenone	<10	<10	<10	<20	<10	<10
4-Aminobiphenyl	<10	<10	<10	<20	<10	<10
Aniline	<10	<10	<10	<20	<10	<10
Anthracene	<660	<660	<660	<1300	<660	<660
Benzidine	<10	<10	<10	<20	<10	<10
Benzo(a)anthracene	<8.7	<8.7	<8.7	<17	<8.7	<8.7
Benzo(a)pyrene	<15	<15	<15	<30	<15	<15
Benzo(b)fluoranthene	<12	<12	<12	<24	<12	<12
Benzo(g,h,i)perylene	<51	<51	<51	<100	<51	<51
Benzo(k)fluoranthene	<11	<11	<11	<22	<11	<11
Benzoic acid	<10	<10	<10	<20	<10	<10
Benzyl alcohol	<20	<20	<20	<40	<20	<20
4-Bromophenyl phenyl ether	<10	<10	<10	<20	<10	<10
Butylbenzylphthalate	<10	<10	<10	<20	<10	<10
4-Chloro-3-methylphenol	<20	<20	<20	<40	<20	<20
p-Chloroaniline	<20	<20	<20	<40	<20	<20
bis(2-Chloroethoxy)methane	<10	<10	<10	<20	<10	<10
bis(2-Chloroethyl)ether	<10	<10	<10	<20	<10	<10
bis(2-Chloroisopropyl)ether	<10	<10	<10	<20	<10	<10
2-Chloronaphthalene	<10	<10	<10	<20	<10	<10
2-Chlorophenol	<10	<10	<10	<20	<10	<10
4-Chlorophenyl phenyl ether	<10	<10	<10	<20	<10	<10
Chrysene	<100	<100	<100	<200	<100	<100
Di-n-octylphthalate	<10	<10	<10	<20	<10	<10
Dibenz(a,h)anthracene	<20	<20	<20	<40	<20	<20
Dibenzo(a,h)pyrene	<10	<10	<10	<20	<10	<10
Dibenzofuran	<10	<10	<10	<20	<10	<10
Dibutylphthalate	<10	<10	<10	<20	<10	<10

(1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.

(2) 4-Methylphenol co-elutes with 3-methylphenol. The value reported is the combined total of the 2 compounds.

ERM - North Central
Radian Work Order: 89-11-134

Method:SW8270-Illinois list (1)

List:SW8270-Illinois list

Sample ID:	MW-1	MW-2	MW-3	MW-4	MW-7	MW-7 BK
Factor:	1	1	1	2	1	1
Results in:	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
	01D	02D	03D	04D	05D	06D
Matrix:	water	water	water	water	water	water

1,2-Dichlorobenzene	<10	<10	<10	<20	<10	<10
1,3-Dichlorobenzene	<10	<10	<10	<20	<10	<10
1,4-Dichlorobenzene	<10	<10	<10	<20	<10	<10
3,3'-Dichlorobenzidine	<20	<20	<20	<40	<20	<20
2,4-Dichlorophenol	<10	<10	<10	<20	<10	<10
2,6-Dichlorophenol	<10	<10	<10	<20	<10	<10
Diethylphthalate	<10	<10	<10	<20	<10	<10
p-Dimethylaminoazobenzene	<10	<10	<10	<20	<10	<10
7,12-Dimethylbenz(a)anthracene	<20	<20	<20	<40	<20	<20
Dimethylphenethylamine	<10	<10	<10	<20	<10	<10
2,4-Dimethylphenol	<u>53</u>	<u>34*</u>	<u>36*</u>	<u>93*</u>	<u>17*</u>	<10
Dimethylphthalate	<10	<10	<10	<20	<10	<10
4,6-Dinitro-2-methylphenol	<50	<50	<50	<100	<50	<50
2,4-Dinitrophenol	<50	<50	<50	<100	<50	<50
2,4-Dinitrotoluene	<10	<10	<10	<20	<10	<10
2,6-Dinitrotoluene	<10	<10	<10	<20	<10	<10
Diphenylamine	<10	<10	<10	<20	<10	<10
1,2-Diphenylhydrazine	<10	<10	<10	<20	<10	<10
Ethyl methanesulfonate	<10	<10	<10	<20	<10	<10
bis(2-Ethylhexyl)phthalate	<u>15*</u>	<u>19*</u>	<u>18*</u>	<u>43*</u>	<u>21*</u>	<u>15*</u>
Fluoranthene	<140	<140	<140	<280	<140	<140
Fluorene	<140	<140	<140	<280	<140	<140
Hexachlorobenzene	<10	<10	<10	<20	<10	<10
Hexachlorobutadiene	<10	<10	<10	<20	<10	<10
Hexachlorocyclopentadiene	<10	<10	<10	<20	<10	<10
Hexachloroethane	<10	<10	<10	<20	<10	<10
Indeno(1,2,3-cd)pyrene	<29	<29	<29	<58	<29	<29
Isophorone	<10	<10	<10	<20	<10	<10
Methyl methanesulfonate	<10	<10	<10	<20	<10	<10
3-Methylcholanthrene	<10	<10	<10	<20	<10	<10

* Est. result less than 5 times detection limit

(1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.

(2) 4-Methylphenol co-elutes with 3-methylphenol. The value reported is the combined total of the 2 compounds.

ERM - North Central
 Radian Work Order: 89-11-134

Method:SW8270-Illinois list (1)

List:SW8270-Illinois list

Sample ID:	MW-1	MW-2	MW-3	MW-4	MW-7	MW-7 BK
Factor:	1	1	1	2	1	1
Results in:	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
	01D	02D	03D	04D	05D	06D
Matrix:	water	water	water	water	water	water

2-Methylnaphthalene	<10	<10	<10	<20	<10	<10
3-Methylphenol(m-cresol)	<10	<10	<10	<20	<10	<10
2-Methylphenol(o-cresol)	<10	<10	<10	<20	<10	<10
4-Methylphenol(p-cresol)	<10	<10	<10	<20	<10	<10
N-Nitroso-di-n-butylamine	<10	<10	<10	<20	<10	<10
N-Nitrosodimethylamine	<10	<10	<10	<20	<10	<10
N-Nitrosodiphenylamine	<10	<10	<10	<20	<10	<10
N-Nitrosodipropylamine	<10	<10	<10	<20	<10	<10
N-Nitrosopiperidine	<10	<10	<10	<20	<10	<10
Naphthalene	<660	<660	<660	<1300	<660	<660
1-Naphthylamine	<10	<10	<10	<20	<10	<10
2-Naphthylamine	<10	<10	<10	<20	<10	<10
2-Nitroaniline	<50	<50	<50	<100	<50	<50
3-Nitroaniline	<50	<50	<50	<100	<50	<50
4-Nitroaniline	<50	<50	<50	<100	<50	<50
Nitrobenzene	<10	<10	<10	<20	<10	<10
2-Nitrophenol	<20	<20	<20	<40	<20	<20
4-Nitrophenol	<50	<50	<50	<100	<50	<50
Pentachlorobenzene	<10	<10	<10	<20	<10	<10
Pentachloronitrobenzene	<10	<10	<10	<20	<10	<10
Pentachlorophenol	<50	<50	<50	<100	<50	<50
Phenacetin	<10	<10	<10	<20	<10	<10
Phenanthrene	<660	<660	<660	<1300	<660	<660
Phenol	<10	<10	<10	<20	<10	<10
2-Picoline	<10	<10	<10	<20	<10	<10
Pronamide	<10	<10	<10	<20	<10	<10
Pyrene	<10	<10	<10	<20	<10	<10
Pyridine	<10	<10	<10	<20	<10	<10
1,2,4,5-Tetrachlorobenzene	<10	<10	<10	<20	<10	<10
2,3,4,6-Tetrachlorophenol	<20	<20	<20	<40	<20	<20

- (1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.
- (2) 4-Methylphenol co-elutes with 3-methylphenol. The value reported is the combined total of the 2 compounds.

ERM - North Central
 Radian Work Order: 89-11-134

Method:SW8270-Illinois list (1)

List:SW8270-Illinois list

Sample ID:	MW-1	MW-2	MW-3	MW-4	MW-7	MW-7 BK
Factor:	1	1	1	2	1	1
Results in:	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
	01D	02D	03D	04D	05D	06D
Matrix:	water	water	water	water	water	water

1,2,4-Trichlorobenzene	<10	<10	<10	<20	<10	<10
2,4,5-Trichlorophenol	<10	<10	<10	<20	<10	<10
2,4,6-Trichlorophenol	<10	<10	<10	<20	<10	<10
<u>Surrogate Recovery(%)</u>						
2-Fluorobiphenyl	96	99	103	102	95	97
Control Limits: 43 to 126						
2-Fluorophenol	107	82	97	104	53	91
Control Limits: 0 to 147						
Nitrobenzene-d5	93	89	92	94	87	84
Control Limits: 23 to 152						
Phenol-d5	88	64	84	89	52	80
Control Limits: 0 to 163						
Terphenyl-d14	100	83	125	92	96	100
Control Limits: 20 to 173						
2,4,6-Tribromophenol	101	78	87	90	76	86
Control Limits: 0 to 157						

- (1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.
- (2) 4-Methylphenol co-elutes with 3-methylphenol. The value reported is the combined total of the 2 compounds.

ERM - North Central
 Radian Work Order: 89-11-134

Method:SW8270-Illinois list (1)

List:SW8270-Illinois list

Sample ID:	MW-8	MW-9	REAGENT BLANK
Factor:	1	1.07	1
Results in:	ug/L	ug/L	ug/L
	07D	08D	11A
Matrix:	water	water	water

Acenaphthene	<1200	<1300	<1200
Acenaphthylene	<660	<710	<660
Acetophenone	<10	<11	<10
4-Aminobiphenyl	<10	<11	<10
Aniline	<10	<11	<10
Anthracene	<660	<710	<660
Benzidine	<10	<11	<10
Benzo(a)anthracene	<8.7	<9.3	<8.7
Benzo(a)pyrene	<15	<16	<15
Benzo(b)fluoranthene	<12	<13	<12
Benzo(g,h,i)perylene	<51	<55	<51
Benzo(k)fluoranthene	<11	<12	<11
Benzoic acid	<10	<11	<10
Benzyl alcohol	<20	<21	<20
4-Bromophenyl phenyl ether	<10	<11	<10
Butylbenzylphthalate	<10	<11	<10
4-Chloro-3-methylphenol	<20	<21	<20
p-Chloroaniline	<20	<21	<20
bis(2-Chloroethoxy)methane	<10	<11	<10
bis(2-Chloroethyl)ether	<10	<11	<10
bis(2-Chloroisopropyl)ether	<10	<11	<10
2-Chloronaphthalene	<10	<11	<10
2-Chlorophenol	<10	<11	<10
4-Chlorophenyl phenyl ether	<10	<11	<10
Chrysene	<100	<110	<100
Di-n-octylphthalate	<10	<11	<10
Dibenz(a,h)anthracene	<20	<21	<20
Dibenzo(a,h)pyrene	<10	<11	<10
Dibenzofuran	<10	<11	<10
Dibutylphthalate	<10	<11	<10

- (1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.
- (2) 4-Methylphenol co-elutes with 3-methylphenol. The value reported is the combined total of the 2 compounds.

ERM - North Central
 Radian Work Order: 89-11-134

Method:SW8270-Illinois list (1)

List:SW8270-Illinois list

Sample ID:	MW-8	MW-9	REAGENT BLANK
Factor:	1	1.07	1
Results in:	ug/L	ug/L	ug/L
	07D	08D	11A
Matrix:	water	water	water

1,2-Dichlorobenzene	<10	<11	<10
1,3-Dichlorobenzene	<10	<11	<10
1,4-Dichlorobenzene	<10	<11	<10
3,3'-Dichlorobenzidine	<20	<21	<20
2,4-Dichlorophenol	<10	<11	<10
2,6-Dichlorophenol	<10	<11	<10
Diethylphthalate	<10	<11	<10
p-Dimethylaminoazobenzene	<10	<11	<10
7,12-Dimethylbenz(a)anthracene	<20	<21	<20
Dimethylphenethylamine	<10	<11	<10
2,4-Dimethylphenol	<u>46*</u>	<u>28*</u>	<u>42*</u>
Dimethylphthalate	<10	<11	<10
4,6-Dinitro-2-methylphenol	<50	<54	<50
2,4-Dinitrophenol	<50	<54	<50
2,4-Dinitrotoluene	<10	<11	<10
2,6-Dinitrotoluene	<10	<11	<10
Diphenylamine	<10	<11	<10
1,2-Diphenylhydrazine	<10	<11	<10
Ethyl methanesulfonate	<10	<11	<10
bis(2-Ethylhexyl)phthalate	<u>18*</u>	<u>25*</u>	<u>21*</u>
Fluoranthene	<140	<150	<140
Fluorene	<140	<150	<140
Hexachlorobenzene	<10	<11	<10
Hexachlorobutadiene	<10	<11	<10
Hexachlorocyclopentadiene	<10	<11	<10
Hexachloroethane	<10	<11	<10
Indeno(1,2,3-cd)pyrene	<29	<31	<29
Isophorone	<10	<11	<10
Methyl methanesulfonate	<10	<11	<10
3-Methylcholanthrene	<10	<11	<10

* Est. result less than 5 times detection limit

(1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.

(2) 4-Methylphenol co-elutes with 3-methylphenol. The value reported is the combined total of the 2 compounds.

ERM - North Central
 Radian Work Order: 89-11-134

Method:SW8270-Illinois list (1)

List:SW8270-Illinois list

Sample ID:	MW-8	MW-9	REAGENT BLANK
Factor:	1	1.07	1
Results in:	ug/L	ug/L	ug/L
	07D	08D	11A
Matrix:	water	water	water

2-Methylnaphthalene	<10	<11	<10
3-Methylphenol(m-cresol)	<10	<11	<10
2-Methylphenol(o-cresol)	<10	<11	<10
4-Methylphenol(p-cresol)	<10	<11	<10
N-Nitroso-di-n-butylamine	<10	<11	<10
N-Nitrosodimethylamine	<10	<11	<10
N-Nitrosodiphenylamine	<10	<11	<10
N-Nitrosodipropylamine	<10	<11	<10
N-Nitrosopiperidine	<10	<11	<10
Naphthalene	100J	<710	<660
1-Naphthylamine	<10	<11	<10
2-Naphthylamine	<10	<11	<10
2-Nitroaniline	<50	<54	<50
3-Nitroaniline	<50	<54	<50
4-Nitroaniline	<50	<54	<50
Nitrobenzene	<10	<11	<10
2-Nitrophenol	<20	<21	<20
4-Nitrophenol	<50	<54	<50
Pentachlorobenzene	<10	<11	<10
Pentachloronitrobenzene	<10	<11	<10
Pentachlorophenol	<50	<54	<50
Phenacetin	<10	<11	<10
Phenanthrene	<660	<710	<660
Phenol	<10	<11	<10
2-Picoline	<10	<11	<10
Pronamide	<10	<11	<10
Pyrene	<10	<11	<10
Pyridine	<10	<11	<10
1,2,4,5-Tetrachlorobenzene	<10	<11	<10
2,3,4,6-Tetrachlorophenol	<20	<21	<20

J Detected at less than detection limit

- (1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.
- (2) 4-Methylphenol co-elutes with 3-methylphenol. The value reported is the combined total of the 2 compounds.

ERM - North Central
 Radian Work Order: 89-11-134

Method: SW8270-Illinois list (1)

List: SW8270-Illinois list

Sample ID:	MW-8	MW-9	REAGENT BLANK
Factor:	1	1.07	1
Results in:	ug/L	ug/L	ug/L
	07D	08D	11A
Matrix:	water	water	water

1,2,4-Trichlorobenzene	<10	<11	<10
2,4,5-Trichlorophenol	<10	<11	<10
2,4,6-Trichlorophenol	<10	<11	<10
<u>Surrogate Recovery(%)</u>			
2-Fluorobiphenyl	96	105	98
Control Limits: 43 to 126			
2-Fluorophenol	93	85	96
Control Limits: 0 to 147			
Nitrobenzene-d5	79	89	83
Control Limits: 23 to 152			
Phenol-d5	93	75	82
Control Limits: 0 to 163			
Terphenyl-d14	84	98	92
Control Limits: 20 to 173			
2,4,6-Tribromophenol	109	88	93
Control Limits: 0 to 157			

- (1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.
- (2) 4-Methylphenol co-elutes with 3-methylphenol. The value reported is the combined total of the 2 compounds.

ERM - North Central
 Radian Work Order: 89-11-134

Sample Identifications and Dates						
Sample ID	MW-1	MW-2	MW-3	MW-4	MW-7	MW-7 BK
Date Sampled	11/13/89	11/13/89	11/13/89	11/13/89	11/13/89	11/13/89
Date Received	11/14/89	11/14/89	11/14/89	11/14/89	11/14/89	11/14/89
Matrix	water	water	water	water	water	water
	01	02	03	04	05	06
SW8240-Illinois list						
Prepared						
Analyzed	11/17/89	11/17/89	11/17/89	11/21/89	11/20/89	11/20/89
Analyst	MCL	MCL	MCL	MCL	MCL	MCL
File ID	75656	75657	75658	75683	75673	75674
Blank ID	75661	75661	75661	75661	75661	75661
Instrument	4501	4501	4501	4501	4501	4501
Report as	received	received	received	received	received	received
SW8270-Illinois list						
Prepared	11/19/89	11/19/89	11/19/89	11/19/89	11/19/89	11/19/89
Analyzed	11/22/89	11/22/89	11/22/89	11/22/89	11/22/89	11/22/89
Analyst	MCK	MCK	MCK	MCK	MCK	MCK
File ID	82992	82993	82994	82995	82996	82997
Blank ID	83000	83000	83000	83000	83000	83000
Instrument	MSD1	MSD1	MSD1	MSD1	MSD1	MSD1
Report as	received	received	received	received	received	received

ERM - North Central
 Radian Work Order: 89-11-134

Sample Identifications and Dates						
Sample ID	MW-8	MW-9	TRIP BLANK #1	TRIP BLANK #2	REAGENT BLANK	SYSTEM BLANK
Date Sampled	11/13/89	11/13/89	11/13/89	11/13/89		
Date Received	11/14/89	11/14/89	11/14/89	11/14/89	11/14/89	11/14/89
Matrix	water	water	water	water	water	water
	07	08	09	10	11	12
SW8240-Illinois list						
Prepared						
Analyzed	11/20/89	11/30/89	11/16/89	11/16/89		11/20/89
Analyst	MCL	DAH	MCL	MCL		MCL
File ID	75675	75764	75634	75635		75661
Blank ID	75661	75661	75661	75661		75661
Instrument	4501	4501	4501	4501		4501
Report as	received	received	received	received		received
SW8270-Illinois list						
Prepared	11/19/89	11/19/89			11/19/89	
Analyzed	11/22/89	11/22/89			11/22/89	
Analyst	MCK	MCK			MCK	
File ID	82998	82999			83000	
Blank ID	93000	83000			83000	
Instrument	MSD1	MSD1			MSD1	
Report as	received	received			received	

Sundstrand Corporation



CORPORATE OFFICES • 4949 HARRISON AVENUE, P.O. BOX 7003 • ROCKFORD, ILLINOIS 61125-7003 • PHONE (815) 226-6000 • TWX 910-631-4255 • TELEX 25-7440

October 25, 1989

Mr. Steve Colantino
Division of Land Pollution Control
Illinois Environmental Protection Agency
2200 Churchill Road
Springfield, Illinois 62706

Re. Sundstrand Plant 6 Investigation

Dear Steve:

Attached is a Work Plan describing the next phase of our investigation at our Plant 6 facility. You will note that we have slightly modified our initial proposed scope of work.

You will see that the proposal includes installing a drift monitoring well approximately 200 feet south of the existing monitoring well 31, as well as installing 2 down gradient monitoring wells across Alpine Road to the west.

Please feel free to contact me at (815) 226-6880 or Al Munn at (815) 226-6934 to arrange a meeting time for when you can observe both the work taking place here during the week of November 6th across Alpine and the well construction at Plant 1 which is tentatively planned for Thursday through Monday, November 2nd through the 6th.

Very truly yours,

SUNDSTRAND CORPORATION

Linda S. Aylward
Senior Associate Attorney

LSA/clis
Enclosure

cc: Kerry Keller, IEPA Rockford
Mark Chiado
William Coole
Al Munn
Paul Rosasco, HLA
Josh Rosen, HLA



October 25, 1989

19356,001.10

Sundstrand Corporation
4949 Harrison Avenue
Rockford, Illinois 61125

Attention: Linda S. Aylward, Esq.

Work Plan
Sundstrand Plant 6 Investigation
Rockford, Illinois

Ladies and Gentlemen:

At your request, Harding Lawson Associates (HLA) has prepared a Work Plan describing our general approach and the specific activities to be conducted during the next phase of our investigation of ground-water conditions at and adjacent to your Plant 6 facility. Specifically, this Work Plan documents activities to be conducted along the western boundary of the facility and in adjacent offsite areas. In addition to describing specific activities, this Work Plan also includes a discussion of the key decision points that may be encountered during our investigation and the criteria for evaluating each decision.

SCOPE OF WORK

It is HLA's understanding that the purpose of this work is to (1) complete onsite characterization, (2) finalize onsite remediation, and (3) evaluate the need for offsite remediation, if any.

The Scope of Work for Plant 6 originally included the following activities:

1. A soil-gas survey of the area downgradient of the Plant 6 site (west of Alpine Road)
2. A survey and inventory of water-supply wells potentially downgradient of the Plant 6 site
3. Installation of a drift monitoring well approximately 200 feet south of existing Monitoring Well 31
4. Installation of a purge well in the immediate area of existing Monitoring Well 31
5. Installation of offsite (downgradient) monitoring wells west of Alpine Road
6. Collection of water level data from all new and existing monitoring wells
7. Development and sampling of all newly installed wells

Engineers
and
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Nevada

Texas

October 19, 1989
Linda S. Aylward, Esq.
Page 2

8. Preparation of a final report that summarizes the results of the above activities and compares site conditions to those described by previous consultants

The necessity and rationale for this work was presented in a report titled "Hydrogeologic Evaluation" prepared by EDI Engineering and Science (EDI) for Sundstrand in May 1989. HLA's technical approach to each of these items is discussed below. Efforts associated with the soil-gas survey and water-supply well survey described above have already been completed.

SOIL GAS SURVEY

The soil-gas survey was conducted from October 3 through October 5, 1989. As originally envisioned, the soil-gas program would consist of 25 sampling locations, 10 of which were to be located along the western boundaries of the Sundstrand property where existing ground-water quality data were available. The purpose of the soil-gas survey was to attempt to identify the optimum locations for offsite well installations. Based on an in-field review of the initial soil-gas sampling results, which was subsequently confirmed by an office evaluation, the soil-gas technique was determined to be ineffective. Specifically, volatile organic compounds (VOCs) were not detected above background concentrations in any of the samples, including those obtained at locations coincident with existing ground-water monitoring wells in which VOCs were detected during EDI's investigation. HLA's initial conclusion is that due to the high clay content of the soils and the high moisture content resulting from recent precipitation, any VOCs volatilized from ground water were effectively restricted from upward migration.

WATER-SUPPLY WELL SURVEY

The survey and inventory of downgradient water-supply wells was completed by referencing City of Rockford records of water-well completions within one mile (downgradient) of the site. Well records, including drilling and completion methods, and depth and length of screened interval were researched and reviewed to provide data to identify downgradient wells completed in the drift and upper portions of the dolomite bedrock. The results of the survey identified that several wells exist approximately one mile to the west (downgradient) of the site and that several wells exist approximately one-half mile to the southwest of the site.

NEW DRIFT MONITORING WELL

A new drift monitoring well will be installed approximately 200 feet south of existing Monitoring Well 31 (see Figure 1). This location will place the well in an area of limited monitoring well coverage within a suspected ground-water trough identified in the EDI report (EDI, May 1989, Figure 7). This well will provide water-quality data for ground water exiting the site through the drift materials. We anticipate that this well will be approximately 50 feet deep.

October 19, 1989
Linda S. Aylward, Esq.
Page 3

NEW PURGE WELL

Because of the low well yield of purge well PW-3, EDI had recommended installing an additional upper bedrock purge well south of PW-3. However, subsequent maintenance of this well by Sundstrand recently resulted in a yield increase in this well from 8 to 13 gallons per minute (gpm). This compares to a maximum design yield of 20 gpm. The increased yield apparently is the result of lowering the placement of the pump within the well. As a result, HLA is not currently proposing to install an additional purge well until the effects of this increased yield can be assessed.

DOWNGRAIENT MONITORING WELLS - PHASE I

Soil-gas results were to be used in siting downgradient offsite monitoring wells. However, because of the limitations of the soil-gas results, proposed wells will be sited solely on the basis of the ground-water level data presented in the EDI report and offsite access considerations. Initially, two monitoring wells will be installed in the upper portion of the bedrock west (downgradient) of purge well PW-3 at distances of approximately 500 and 1500 feet west of the western boundary of the Sundstrand property (see Figure 1). The exact locations will depend on access considerations and a site inspection to be conducted on October 17, 1989.

WATER LEVEL MEASUREMENT

HLA will obtain water level measurements from all new and existing wells in an approximate one to three day period to insure consistency between the various measurements.

WELL DEVELOPMENT AND SAMPLING

All newly constructed wells will be developed by a combination of surging and pumping until the water appears to be clear and free of sediment. HLA will sample all new wells and existing onsite monitoring wells to comply with Sundstrand's quarterly ground-water monitoring program at this facility. The samples will be analyzed for VOCs using EPA Methods 601 and 602. Hazleton Laboratories of America of Madison, Wisconsin, will analyze ground-water samples.

DOWNGRAIENT MONITORING WELLS - PHASE II

Based on the results of the monitoring-well sampling and chemical analyses, additional downgradient monitoring wells may be installed. Specifically, if the westernmost monitoring well contains significant levels of organic compounds attributable to Sundstrand, additional upper bedrock monitoring wells may be installed further west and/or north or south of the Phase I downgradient wells. In addition, if the new drift monitoring well to be installed along the western property boundary contains significant concentrations of organic compounds, additional downgradient drift wells may be installed. Any additional wells that may be installed will be adequately developed and then sampled for VOCs.

October 19, 1989
Linda S. Aylward, Esq.
Page 4

FINAL REPORT

A final report will be presented to Sundstrand following the completion of Phase II. This report will summarize the results of all HLA activities described above and will present a comparison of HLA's findings with those of previous consultants who have completed work at the site.

MONITORING-WELL CONSTRUCTION

HLA proposes to install the monitoring wells and purge well (if required) according to procedures described in the following paragraphs:

1. The borings will be drilled using a truck-mounted drill rig with air-rotary equipment. Hollow-stem auger equipment will be available if a thick sequence of unconsolidated material (drift) is encountered above bedrock.
2. An HLA geologist will coordinate the drilling, log the unconsolidated material (e.g., drift) and bedrock encountered, and obtain samples for visual examination and soil classification. Drift and bedrock will be classified in accordance with the Unified Soil Classification System (USCS) and Physical Properties Criteria for Rock Descriptions. All sampling procedures and equipment will conform to American Society for Testing and Materials (ASTM) standards.
3. Drift, where encountered, will be sampled at approximately 5-foot intervals or at changes in lithology with a Modified California sampler or split-spoon sampler. Samplers will be driven with a 140-pound hammer falling 30 inches. The number of blows required to drive the samplers will be converted to standard penetration test blow counts and will be presented on the boring logs. Samples will be retained for lithologic description and comparison.
4. The monitoring wells will be completed with 2-inch-diameter flush-threaded stainless-steel casing and screen and galvanized steel casing. The screen is anticipated to be 10 feet long, 0.020 slot, with a 10-20 silica sand pack placed to a height of 2 feet above the top of screen. Ten feet of stainless-steel casing will be placed above the screen, and the well will be completed to ground surface with galvanized steel. A 2-foot-thick bentonite pellet seal will be emplaced above the sand pack, and the remainder of the annular space will be backfilled with cement-bentonite grout. The grout will consist of Portland cement with 5 percent (by weight) bentonite powder added to prevent shrinkage. Approximately 6 gallons of potable water will be added per 94-pound bag of cement.
5. For wells completed in bedrock through a considerable thickness of unconsolidated material (drift), 6-inch-diameter pipe (PVC or black steel) will be utilized as a conductor casing to isolate the well bore from infiltration from water-bearing layers penetrated above. The conductor casing will be grouted by the Halliburton method.



October 19, 1989
Linda S. Aylward, Esq.
Page 5

6. To ensure that available formation water is entering the wells in an efficient manner, the wells will be developed before the HLA field investigation team leaves the site. The wells will be developed by a combination of surging and pumping until the water appears to be clear and free of sediment. It is anticipated that HLA will procure the services of Wehling Well Works of Beecher, Illinois, to drill and install the monitoring wells. Well sampling will be conducted by HLA no sooner than one week after the completion of well construction and development. Ground-water samples will be analyzed for VOCs by EPA Methods 601 and 602.

REPORTING

HLA is preparing a letter report to transmit the results of the soil-gas survey and water-supply well inventory. In addition, data collected from the field program, including soil-gas data, well survey results, boring logs, well completion diagrams, water level measurements, results of the laboratory analyses, and comparisons of HLA data with previously generated site data, will be presented to Sundstrand in a final report. This report will also include recommendations, if any, for additional monitoring wells or other Phase II work that may be appropriate.

SCHEDULE

Phase I field work is anticipated to take approximately one month beginning Monday, October 30, 1989. Turnaround for the laboratory analyses is anticipated to take 30 days, and an additional three weeks will be required to finalize the report.

We greatly appreciate the opportunity to work with you on this project. Please do not hesitate to call if you have any questions or require additional discussion or clarification.

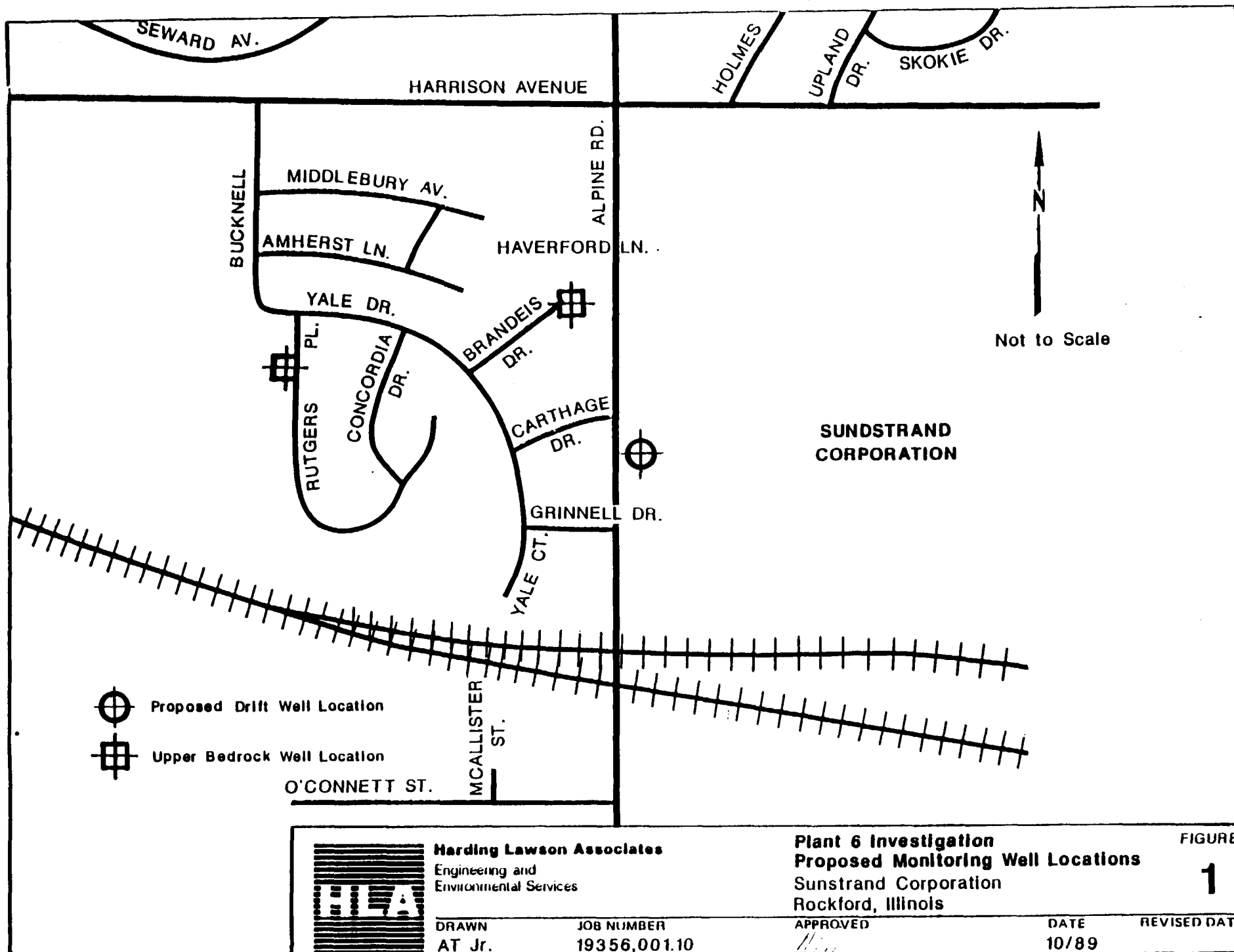
Yours very truly,

HARDING LAWSON ASSOCIATES

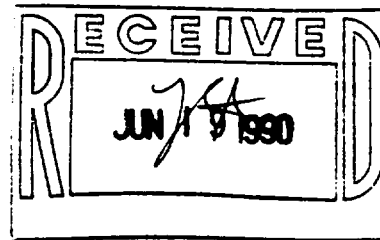

Paul V. Rosasco,
Senior Vice President

PVR/MMM/ja

cc: Al Munn - Sundstrand
Michael Malley - HLA
Josh Rosen - HLA



June 18, 1990



Ms. Linda S. Aylward
Senior Associate Attorney
Sundstrand Corporation
4949 Harrison Avenue
P.O. Box 7003
Rockford, IL 61125

Dear Ms. Aylward:

Geraghty & Miller, Inc. is pleased to submit this proposal to Sundstrand Corporation for soil remediation at the Suntec Industries, Inc. (Suntec) facility located in Rockford, Illinois. We have reviewed the Soil Remediation Investigation report prepared by Environmental Resources Management-North Central, Inc. (ERM) for the Suntec facility. We have relied on the information contained in this report regarding the stratigraphy at the site, and also the extent of soils that have been affected by volatile organic compounds (VOCs) to formulate a remediation plan based on a soil vapor extraction system (SVES).

BACKGROUND INFORMATION

Previous investigations have defined a target area for soil remediation adjacent to the main facility building near the oil room. The approximate dimensions of this area are 75'ft.W x 150'ft.L. This area has been designated as Area 1 in the Soil Remediation Investigation report prepared by ERM. The following VOCs have been detected in soil samples obtained from soil borings advanced in this area: tetrachloroethylene; trichloroethylene; 1,1,1-trichloromethane; and xylene.

Based on the soil borings that have been completed to date, ERM has provided the following interpretation of the stratigraphy encountered in Area 1:

- 0-9ft. below ground surface (bgs), medium to fine-grained sands;
- 9-15ft. bgs, silt interbedded with sand lenses; and
- 15ft. saturated zone (depth to water table is not specified in the Soil Remediation Investigation report and could impact the operation of a SVES).

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Ms. Linda S. Aylward
June 18, 1990
Page 3

The vapor extraction well pairs and monitoring probes would be installed using hollow-stem auger drilling techniques. Soil samples would be collected continuously from the boreholes using a split-spoon soil sampler to provide samples for lithologic description to estimate the consistency of the stratigraphy and its physical properties that affect air permeability. A portable organic vapor analyzer (OVA) would be used to perform the infield analysis of VOCs. A representative soil sample from each split-spoon would be immediately placed in a glass jar and covered in preparation for the headspace analyses. The samples would then be allowed to equilibrate to room temperature before a headspace VOC reading was recorded using the OVA. In addition, selected soil samples would be retained and submitted to a geotechnical laboratory for grain-size analysis. The soil cuttings and decontamination water which would be produced during completion of the drilling and decontamination activities would be contained in 55-gallon drums pending proper treatment and/or disposal. The above measurements would provide better information pertinent to the determination of the length of time to achieve cleanup levels.

The vapor extraction wells would be constructed of 2-inch diameter PVC casing with a 2-inch diameter, 0.020 slot PVC screen. The vapor extraction wells would be completed by backfilling the borehole with coarse-grained sand to a height of approximately one foot above the screened interval. A bentonite seal would then be placed above the sand pack to prevent the flow of surface air through or along the well annulus and short circuiting the flow of subsurface air to the well. The probes would be constructed of 1-inch diameter PVC pipe with 18-inch long screens. The monitoring probes would also be completed by backfilling the screened interval of the probe with coarse-grained sand. As with the vapor extractions wells, a bentonite seal would be placed above the sand pack to prevent surface air from short-circuiting the flow of subsurface air to the well.

The vapor extraction wells and monitoring probes would be finished with flush-mounted well boxes that are intended for use in areas of traffic flow. The flush-mounted well boxes would minimize the visual impact of the SVES and eliminate obstacles to traffic entering and exiting the area. The area would be compacted and regraded to induce surface runoff that would otherwise percolate into the soils and impair the performance of the SVES. The compacted earthen material would also serve as a low permeability cap that will enhance uniform distribution of a subsurface vacuum.

BLOWER AND COLLECTION HEADER

The vapor extraction wells would be connected to the blower via a collection header constructed of 4-inch diameter PVC piping that would be buried in a trench at a depth of approximately 4 to 5 feet. The collection header would be designed to accommodate the installation of additional vapor extraction wells to the system, if deemed necessary from the analysis of operation data. A series of valves and monitoring ports would be installed within the

Ms. Linda S. Aylward
June 18, 1990
Page 4

blower and collection header system to regulate the air flow and allow for the measurement of velocity, pressure and soil gas composition. The negative pressure potential of the blower on the vapor extraction well would be moderated by the installation of a throttling valve.

A protective structure would be constructed to house the blower and muffle the noise developed by the blower. This structure would be enclosed by exterior fencing. The blower, collection header, protective structure, and exterior fencing would be constructed subsequent to completion of a soil vapor extraction test.

An extraction test would be conducted over a one week period on the SVES following the installation of the vapor extraction well pairs and monitoring probes and prior to the installation of the collection header and blower. The test will provide information regarding the efficiency and zone of influence of the SVES, the level of VOCs exiting from the system and the level of gaseous VOCs present in the area of the monitoring probe screens. A minimum of eight air discharge samples would be collected during the test and submitted to the project laboratory for VOC analysis. The results of the test would be used to provide information necessary to evaluate the potential need for additional extraction wells. However, based on the information thus far made available to us, it is probable that a total of four wells, two in each stratigraphic unit will suffice.

SVES MONITORING

Subsequent to the SVES system full-scale start-up, monitoring of the system discharge would be conducted on the following schedule:

- Daily for a period of two days
- weekly for a period of four weeks
- monthly for a period of six months.

ESTIMATED COSTS

The estimated costs to design and install the SVES as described are presented below. A 15 percent project contingency has been added to the total capital costs to off-set any additional efforts needed to complete the installation activities, or to account for unanticipated field conditions.

Ms. Linda S. Aylward
June 18, 1990
Page 5

CAPITAL COST

Design of System	\$ 6,000
Site Preparation, Grading	1,200
Installation of Two Vapor Extraction Well Pairs (4 wells)	10,000
Installation of Monitoring Wells	4,000
Vacuum Blower	2,500
Instrumentation and Controls	800
Electrical Hook-Up	2,500
Piping Installation (valves, tees, pipeline)	8,000
Concrete Slab and Enclosure	1,500
Security Enclosure	1,000
Oversight/Coordination of Subcontracting	6,000
Analytical Measurements	4,000
System Start-Up	<u>6,000</u>
Total Estimated Capital Costs	\$53,500
Contingency, 15%	<u>8,000</u>
Total Capital Costs	\$61,500

OPERATING COSTS (6 months)

Six Monitoring Trips (includes extraction tests)	\$ 9,000
Laboratory Analysis	6,000
Electricity	800
Total Estimated Operating Costs	<u>\$15,800</u>

Ms. Linda S. Aylward
June 18, 1990
Page 6

In order to provide you with an expected range of capital costs for soil remediation at the Suntec facility, we have also prepared a cost estimate for the SVES configuration presented by ERM in the Soil Remediation Investigation report. The ERM design consists of eight vapor extraction wells and 14 air inlet wells. The cost estimate for this design is intended to represent the upper end of the cost range for a SVES to remediate the site.

The design approach adopted by ERM consists of addressing the whole of Area 1 from the outset, rather than proceeding in a phased approach and modifying the initial SVES as needed, based on operating data obtainable from the initial system start-up.

We strongly emphasize that the following cost estimates are based only on the information made available to us. Our interpretation of ERM's proposal could vary should we be privy to more information or if we had the opportunity to discuss the ERM proposal with the engineer.

The estimated capital costs for the SVES configuration proposed by ERM are presented below.

CAPITAL COSTS

Design of System	\$ 15,000
Install Vapor Extraction Wells	14,000
Install Air Inlet Wells	14,000
Site Civil (includes utility equipment housing trenching and asphalt cap over affected area (cap was proposed by ERM))	38,000
Mechanical (includes 30 Hp. air blower, air/water separator, valves, gauges, piping and installation)	25,000
Electrical (includes electrical panel, conduit and installation)	6,000

GERAGHTY & MILLER, INC.

Ms. Linda S. Aylward
June 18, 1990
Page 7


Oversight/Coordination of Subcontracting	12,000
Analytical Measurements	6,000
System Start-Up	<u>5,000</u>
 Total Estimated Capital Costs	 \$135,000
Contingency, 15%	<u>20,000</u>
	 \$155,000

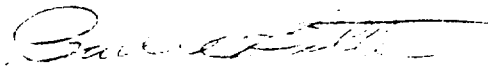
We have not produced an o/m cost estimate for the ERM proposal since variations in the operation of the air-injection wells will vary the estimates, substantially.

Please call us if you need clarification of these cost estimate or have any further inquiries.

Sincerely yours,

GERAGHTY & MILLER, INC.


Richard E. Bartelt, P.E.
Vice President
Director, Engineering Services
Midwest Region


Paul R. Bitter, P.E.
Principal Engineer

If